SEVENTY-FOURTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXVIII. NUMBER 13 | NEW YORK, MARCH 30, 1918 | 10 CENTS A COPY $4.00 A YEAR

This submarine saw, measuring anywhere from 30 to 300 feet, enables two men to clear a wide expanse of weed-covered water during a working day

Cleaning Lakes of Weeds with the Submarine Saw

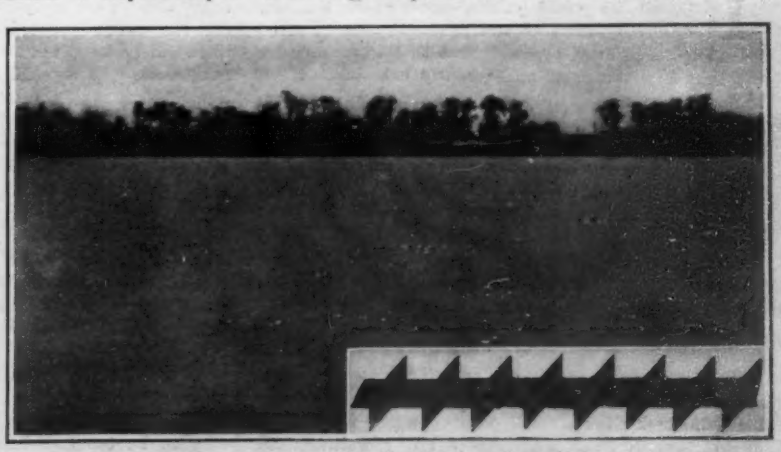
BY means of a long, thin saw fitted with torpedo-shaped sinkers at intervals, the problem of cleaning lakes of weeds appears to have been solved. Indeed, without any previous experience whatsoever, two unskilled workmen or even boys can clear a good sized expanse of water in a day's time with the submarine saw.

The new weed-cutting saw, simple as it is, makes it an easy matter to cut the rushes, lily-pads or any other aquatic growth from any body of still or running water. It is perfectly adapted to clearing the plant growth from bodies of water from which ice is to be harvested; also for clearing rivers, streams, canals, water trenches, fish ponds, lakes, bathing places, places for drawing fishing nets or for fishing, drives for duck shooting, and for clearing muddy streams by cutting away the roots which retain the mud. Even the toughest reeds and water grasses are cut without difficulty, as the plants are cut off close to the roots where the shoots are soft and tender. Cutting off close to the roots has a double advantage, as it makes the work much easier and retards the future growth of the plant. In many cases this method of cutting, when the plants have reached a good state of development, completely clears the water for the entire season.

The main member of the submarine saw is the toothed steel band made of special quality steel that will last for years with ordinary wear. In fact, one of the greatest difficulties to overcome in this case was the necessary flexibility of the saw; and it needs a special and long process of tempering to produce the right combination. The steel mostly comes out too brittle, and many pieces are rejected before a satisfactory one is produced. When used in water that is free from rocks and boulders, the submarine saw will last a reasonable length of time, for its fine temper permits it to take the contour of the bottom with the ease of a snake and with the minimum chance of breaking. If the saw should happen to break or be badly damaged by coming in contact with rocks, it can be repaired or even replaced at a trifling expense. Clamps for coupling the saw to draw-ropes are provided at each end, as well as a number of torpedo-shaped sinkers. The saw can be used in any desired length, from ten yards to a hundred yards.

Two persons are required to operate the weed-cutting saw, one at each end. First one man gives a steady pull of two or two and a half feet, and then the other man, and each advances slowly as he pulls. In running water it is better to cut against the stream, with one end a little higher up-stream. The torpedo-shaped sinkers are screwed on at intervals of one to one and a half yards. In the case of ponds or streams of over thirty yards in width, it is usually advantageous to saw without sinkers and to use weights on the draw-ropes only, because the saw when 30 yards long is apt to sink into the mud and hinder the work. In instances where the body of water is too wide to be worked from opposite shores, a boat or pair of boats is required. No difficulty attaches to clearing the cut plants from the water, for in running water they float down stream. When clearing a lake or pond, the weeds can be easily raked to shore by two men in boats trailing a rope between them, or, if a brisk wind is blowing, the plants will be blown to shore.

Lake covered with water grass. Torpedo-shaped sinker in insert



Same lake after saw was used. Section of saw in insert

SCIENTIFIC AMERICAN

Founded 1845

Published by Munn & Co., Inc., 233 Broadway, New York, Saturday, March 30, 1918

Charles Allen Munn, President, Frederick C. Beach, Secretary, Orson D. Munn, Treasurer, all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office

The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Our First Year of War

IT is appropriate and timely that the next issue of the SCIENTIFIC AMERICAN, which will bear the date of ou entrance into the great world war, should be devoted to a record of our achievement during the past moment us twelve months of our history.

The anniversary falls at a time when the country is passing through an era of criticism, investigation and readjustment. We do not deplore this criticism; rather, we welcome it as being conducive in its ultimate effect to enlightenment and efficiency, the consolidation of public confidence, and the stiffening of national morale.

At the same time, we feel that these frequently recurring investigations have perhaps directed public attention so strongly to the things which we have not done as to lead us to overlook, or forget altogether, the great things which we have done; and it is the express purpose of our forthcoming issue to give a condensed but comprehensive view of the actual accomplishment of the United States in working out the stupendous problem of transforming the country from a Nation at peace to a Nation at war—a task, in other words, of doing within twelve months the things which might well have taken as many years of strenuous work for their accomplishment.

We realize that, to carry its full value, an issue of this kind cannot be too highly authoritative, and it gives us much pleasure to announce that the whole of this number will be written by various members of the Cabinet and the heads of the special commissions and departments which have been created to meet the emergencies of the war. No one, of course, is so well qualified to give a *multum in parvo* statement of the complicated and far-flung activities of a great Government department as the head of that department himself; and, seeing that the forthcoming issue will contain articles by the Secretaries of War, the Navy and Labor, by the Chairmen of the Shipping Board and of the Committee on Information, by the Administrators of Food and of Fuel, by the Secretary of the Council of National Defense, and by other Government Officials, it will be realized that this War Number will be informing and authoritative to the highest degree.

Lieutenant Farré's Paintings

THE war in the air has been brought home to us in all its vivid colors, spectacular touches, dramatic moments and practical uses. In the splendid collection of canvases sent to this country by the French government and recently exhibited at the Anderson Galleries in New York city, under the supervision of the French Military Mission to the United States, such of us as have been fortunate enough to visit the exhibition have indeed been brought face to face with aerial warfare of three and a half years gone by.

The paintings are more than worthy pieces of art: they are vivid reports of aerial activities. For the artist is none other than Lieutenant Farré, who has served as Observer-Bombardier with the 1r Groupe d'Escadrille de Bombardement, participating in practically all the great raids over German cities and munition centers, such as Karlsruhe, Dieuze and Metz. His paintings have been made at such times as he could snatch a brush instead of dropping a bomb or handling a machine gun. During his flights he has taken notes—artist's notes—in the form of sketches, color values and combinations, waiting until an odd moment at the base to work the data into a finished painting. So the usual element of imagination has been reduced to the irreducible minimum in Farré's canvases: his pictures are for the most part eye-witness reports. Which makes them all the more interesting and valuable.

Whatever has been thought regarding the airplane, the collection of Lieut. Farré is convincing. Aerial bombardments over German cities are shown in all their splendor and terror, and no one will gainsay that they are important militarily. Contact work between infantry and airplanes over the blasted fields of the Somme are vividly portrayed, with Farman pushers and Caudron twin-engined biplanes flying a few hundred feet above the straggly line of *poilus*, advancing to the attack. The rolling barrage fire is shown mowing its way over Dead Man's Hill north of Verdun, with biplanes above signaling back to the artillery. A parachute carrying a large French flag is seen released from an airplane, serving as the signal for the attack in one of the big Verdun battles. Low-flying machines are pictured sweeping along German trenches and killing and wounding their occupants with bursts of machine-gun fire. Lastly, and most important of all, French, British and German machines are shown in all manner of aerial combats, with all that wealth of adventure which is part and parcel of the war in the skies.

Lieut. Farré tells us in his paintings that the airplane has not been overestimated. It has developed far beyond the most vivid expectations of pre-war days. An army today needs airplanes; the more airplanes it possesses and the better its airplanes, the more certain are its chances of success.

That is the message from the battlefields of France. The call is urgent. We should bend every effort and muster every resource in speeding our aircraft production, if we are to place in the hands of our Army the best of weapons to win the war.

The Yearbook of the Carnegie Institution

SERENE amid the wreck of matter and the crash of worlds, the Carnegie Institution of Washington smiles upon us from the pages of its 1917 Yearbook —and we hardly know whether to admire or to deprecate its imperturbability. We long for Director Woodward's playful and phraseological pen to help us debate this question.

In what temper are we to wend our way through this impeccable volume? Can we find sanctuary betwixt its covers from the turmoil of wars and politics; or will not rather the cries of hapless humanity pursue us to its very penetralia? Certain images will inevitably come to our mind as we read—the Roman senators, whose godlike dignity overawed Brennus and his Gauls; Gallileo, who "cared for none of those things"; Mrs. Jellyby, with eyes sweetly fixed through domestic hubbub, on Borrioboolo-Gha.

The case of the Carnegie Institution is as handy a pretext as any other for raising a question to which perhaps, posterity alone can supply a conclusive answer. On the one hand we behold scientists and scholars by the hundred—men of rare talents and free from the slightest imputation of that mental aberrancy which is the Woodwardian *bête noire*—laying aside their habitual and momentous employments to prove how keenly they "feel with men in the agonizing present," and, on the other, the members of Doctor Woodward's happy family beguiling their cloistered hours with consummation of a Concordance to the Poems of John Keats; a task which, we are informed, entailed the cooperation of "a zealous company of six editors, assisted by no less than twenty-four collaborators." Is there room in the world at this moment for both kinds of activity?

Certainly the juxtaposition of a Keats concordance with a worldful of unparalleled discordance is startling and provocative of reflection. We have no personal grudge against Keats, notwithstanding the vituperative remarks he once let fall concerning the exponents of atmospheric optics. His purblind opinion of the unriddled rainbow is a boomerang which falls upon his own head, and we are sorry for him. Neither do we underrate the value of concordances. It is a pity they are not more widely used; not merely for the purpose of locating quotations, but especially as supplements to the dictionary in resolving questions of verbal and syntactical usage.

Indeed, as we plod on, we find plenty of other equally striking proofs of the fact that "Research as usual" is the Carnegie policy. "Science enough and exploring!" Ulugh Beg's star catalogue at last set to rights; new Maya inscriptions in Honduras; uncial manuscripts of the seventh century; Pleistocene vertebrates; comparative studies on *Drosophila*. . . . The word "war" catches our eye, but leads to nothing more tinged with *actualité* than a dissertation on the war clubs of Polynesia.

All of this is magnificent, but it is not real war. Shall we be glad or sorry that, here and there, human minds are still untouched by the universal upheaval? It is easy to be too confident in answering this question. We are prone to forget that the world has passed through other crises as grave as the present one—the Reformation, for example. In Luther's day was it the bounden duty of every philosopher to abandon his peaceful pursuits and engage in bloody or inky polemics? Would not the world be poorer today if all had done so?

The whole question is debatable. Provisionally, the worst we can say of the current budget of intelligence from our leading unofficial research establishment is that we would have forgiven it for evincing a little more agitation about events that threaten to sap the very foundations of science and scholarship. *Punch* announced the other day that through the splendid 100-inch telescope—the largest in the world—which the Carnegie Institution has just erected on Mount Wilson, the end of the war would be distinctly visible. We should like to get glimpses of the same blessed event through some of the other achievements of the Institution.

A Decade of Pure Food

TWENTY-FIVE years of popular agitation were required to overcome Congressional inertia and hostile lobbying on the part of manufacturers and secure the passage of the momentous Food and Drugs Act of June 30, 1906. The first ten years of the enforcement of the act having ended January 1, 1917, the current annual report of the United States Bureau of Chemistry makes this fact the occasion of an interesting retrospect. Perhaps the strongest impression we gain in reading it is one of amazement at the uphill work that was entailed in putting so badly needed a law on the statute books; especially when our national legislators had before them the encouraging history of similar undertakings in Great Britain and elsewhere.

The enforcement of the Food and Drugs Act has kept the Bureau of Chemistry busy. "To state," says the report, "that more than six thousand cases have been terminated in the courts since the enactment of the act; that manufacturers have been cited to hearing more than forty thousand times, that many thousand factory inspections have been made, that more than seven hundred and fifty thousand shipments of food and drugs, both domestic and imported, have been examined, gives but an imperfect indication of results."

One of the most notable indirect consequences of this law has been the enactment of similar legislation in the several states, to control traffic that does not cross state lines, and to which Federal law does not, therefore, apply. Such laws existed in some states, but not in others; and in the past both the state laws and the definitions and standards prescribed under them have been so heterogeneous as to impose hardship and vexation upon manufacturers engaged in interstate business. With the advent of Federal laws and regulations a movement toward uniformity was set on foot. This has been promoted by the Joint Committee on Definitions and Standards (consisting of representatives of the Department of Agriculture, the Association of American Dairy Food and Drug Officials, and the Association of Official Agricultural Chemists) and a recently established branch of the Bureau of Chemistry, known as the Office of Coöperative State and Federal Food and Drug Control.

Another result of the Federal pure food law, indirect in the sense that it is not one immediately affecting the general public, is the beneficial influence it has exerted upon the producing industries. In protecting the public from adulterations and misrepresentations the law also protects the honest manufacturer against his unscrupulous rivals. Moreover, the Government has sought all along, not merely to punish violations of the law, but to prevent their occurrence by improving and standardizing methods of production. This fact is now fully recognized by manufacturers, who, in coöperating with the Government, have been drawn together in associations for mutual benefit not unlike the guilds of the Middle Ages. The Food and Drugs Act and the activities involved in its interpretation have stimulated scientific research on the part of the manufacturers and their associations, the general result of which has been better and cheaper products.

Of course the average citizen is more especially interested in the work done under this act in detecting and preventing adulterations, misbranding, and the like. The record of these activities presents a picture of sordid commercialism and heartless avarice which needs to be taken to heart by those who make plans for our country's future. There is much talk nowadays about capturing world markets after the war, but we must prayerfully hope that no participation in such conquests will be vouchsafed to American manufacturers who are engaged in—or only prevented by the stern hand of the Government from—defrauding and poisoning their compatriots with sophisticated foods and drugs. Their products represents all degrees of iniquity, from chicory *camouflé* as coffee and "lithia water" containing an infinitesimal amount of lithium, to fake cancer cures, and murderous headache mixtures. Although the original Food and Drugs Act has been amended from time to time in order to remedy its defects and extend its scope, there are still serious loopholes—and, sad to say, plenty of rascals to take advantage of them.

Electricity

From Berlin to Australia by Wireless.—Commander Creswell, R. A. N., told an audience at the United Service Institute, Melbourne, recently that messages from the station at Nauen, near Berlin, were regularly received in Australia, both at Perth and at Sydney. The distance to Perth is approximately 7,000 miles, while to Sydney via America, across which it is presumed the wireless waves travel, the distance is about 12,000 miles. In the opinion of Commander Creswell this constitutes a world's record.

Increase Your Crops By Electric Treatment.—In a recent issue of *L'Industrie Electrique* there appears an interesting description of the electrical apparatus employed in France to stimulate agricultural production. Experiments have shown an increased growth under this treatment as follows: Young strawberry plants, 80 per cent; old strawberry plants, 25 to 36 per cent; potatoes, 20 to 50 per cent (in the size, not the number of the potatoes); carrots, beets and tomatoes, 20 to 50 per cent. Quite an important advantage in the employment of this treatment is said to be the destruction of worms and insects that usually prey upon the plants.

An Artificial High-Tension Line.—In a recent issue of *Elettrotecnica*, Prof. L. Lombardi describes an interesting experimental high tension line which has been constructed in the laboratory of the Polytechnic Institute at Naples. Facilities are available for the application of a pressure of 60,000 volts to the line, and it is hoped that it will afford a useful means of testing in the laboratory various practical points involved in high-tension transmission. The device deserves attention. It is possible that in the near future high-tension transmission will play a still greater part in the electrical industry, hence now is the time to undertake investigations on this subject.

Copper-Clad Steel Wire is strongly advocated in these days of war economy, when copper is selling at almost prohibitive prices. For use as service connections between main feeders and house, for instance, No. 8 or No. 10 copper-clad steel wire in the place of No. 6 or No. 8 copper will show a saving of 40 to 50 per cent in first cost, besides securing much higher strength—an important factor in reducing maintenance. These are substantial savings, indeed. The conductivity of No. 8 and No. 10 copper-clad steel wire is equivalent to the interior copper wire generally used. Among other uses for this wire are power lines, long spans, series arc circuits, telephone circuits, ground wire, choke coils, ground rods and railroad crossings.

The Steadily-Improving Battery Searchlight.—From the pocket flashlamp operated by two or three dry cells of minute size, the battery searchlight has been steadily improved until today remarkable results are obtained. Some time ago an illustrated article describing a searchlight of 500-foot range appeared in these columns, operating on six or eight volts. More recently a battery searchlight has been introduced with a range of 2,000 feet up to half a mile, operating on six volts. Equipped with a 7½-inch adjustable focus, single shell reflector, on a recent photometer test one of these searchlights gave 453,000 candle-power. The combination of a nitrogen-filled tungsten lamp and a correctly designed reflector has worked wonders for the battery-operated searchlight.

Mirror Surface on Blown-Out Bulb.—Dr. Julius E. Bach of Chattanooga, Tenn., shows us a rather interesting phenomenon. A small bulb was burned out by excessive voltage on his auto-generator; and on removal, it was observed that the interior of the bulb was covered with a blackish substance which gave it a perfect mirror surface. Barring the slight distortion due to its shape, it presents as admirable a glass as anyone could wish. We are familiar with the deposit of platinum which follows the puncturing of an incandescent bulb with a tiny airhole, and which makes a first class reflecting surface of the bulb; but this seems to be another thing altogether. Perhaps some reader who has noted the same thing and investigated it can tell us whether the film here consists of platinum or of the metallic filament material.

The Toggle Snap Switch has at last made its debut in the American market. For years the toggle switch has been the standard in England and in some of the Continental countries, but we have always preferred to keep to our rotary snap switches for some reason or other. A Bridgeport manufacturer has finally undertaken to manufacture toggle snap switches which differ from the ordinary snap surface switch in that manipulation is by the throw of a lever or toggle, instead of by the turning of a key or button. Throwing the lever up makes the circuit; throwing it down breaks the circuit. The advantages claimed for the toggle movement in a surface switch are, first, that it permits making the switch more attractive and stronger than the ordinary switch; second, manipulation is much more convenient; third, the switch is self-indicating, the position of the lever showing at a glance whether the current is "on" or "off."

Science

Agricultural Experiment Station in Santo Domingo.—The military government of Santo Domingo has authorized the establishment of an agricultural experiment station. A site has been selected about ten miles west of the capital, and preparations for building are under way.

A Department of Exploration and Research has been organized in the American Geographical Society, and funds have been secured for a broad program of work during the year 1918. Thus our leading American geographical organization will henceforth be able to exercise the functions of a geographical institute, as the term is employed abroad. The society is publishing, apart from the *Geographical Review*, a series of monographs. This year the society expects to issue a striking book, exceptionally well illustrated, dealing with the relation of physical geography to military strategy on the European battle fronts; also a translation and review of the diaries kept by the Danish mariner Bering during his Northwest voyages.

Discharge Tubes for Rare Gases have been a subject of recent experiments at the Bureau of Standards. Such tubes provide a means of examining the spectra of rare gases; they are made of glass or quartz and equipped for passing an electrical discharge through the contained gas. The Bureau has made tubes containing hydrogen, helium and argon. The last-named gas was obtained directly from air. A small bulb of quartz or Pyrex glass was filled with calcium chips and attached to a tube containing air. The calcuim was then maintained at a temperature of about 300 degrees C. for several hours; this process extracts all the nitrogen and oxygen from the enclosed air and leaves quite pure argon in the tube, at about the right pressure for spectroscopic work.

The Magnetic Survey of the United States.—The original plan for the magnetic survey of the United States, as laid down by the Coast and Geodetic Survey in 1899, provided for a first general survey, with stations thirty to forty miles apart; to be followed by a more detailed study of magnetically disturbed regions. In carrying out this plan the attempt has been made to have at least one magnetic station in each county, so that county surveyors may be provided with the data necessary for testing their compasses; observations have, accordingly, been made at nearly all county seats, and more detailed observations have been made in regions of marked local disturbance. The data accumulated by the Survey have been published from time to time in the form of tables and charts. The latest publication of this kind, containing the results of all observations down to the end of 1916, and the corresponding values for January 1st, 1915, has recently appeared as Special Publication No. 44, "Terrestrial Magnetism, United States Magnetic Tables and Charts for 1915."

More Light on Dr. Cook.—In the *Geographical Review* for February, 1918, Mr. Donald MacMillan, leader of the recent Crocker Land Expedition, gives an interesting reconstruction of the route of Dr. Cook on his alleged journey to the North Pole. Mr. MacMillan's party secured the services of the two Eskimos, E-took-a-shoo and Ah-pellah, who accompanied Cook on the journey in question. According to these men, who are said to have a remarkably accurate sense of location, the most northerly point reached by Cook was a place on the polar sea north of Axel Heiberrg Island 500 miles from the Pole. The locations of several of the places of which photographs appear in Cook's "My Attainment of the Pole," were identified as being remote from the locations ascribed to them by the author. "Mending Near the Pole," was taken on the west side of Axel Heiberg Island (550 miles from the Pole); "At the Pole" was taken near Cape Faraday on the east coast of Ellesmere Land (780 miles from the Pole); "First Camp at the Pole, April 21st, 1908," was taken in the spring of 1909 a little south of Cape Faraday.

Radium Extraction by the Bureau of Mines.—The largest deposits of uranium-bearing ore in the world are situated in southwestern Colorado and eastern Utah. In order to demonstrate the value of these deposits the Bureau of Mines made an arrangement with the National Radium Institute, whereby the Government was able to experiment on the treatment of carnotite ore and incidentally to retain in this country a supply of radium for two of our important hospitals. During the period from 1914 to 1916 more than eight grams of radium was obtained at a cost of less than $40,000 per gram. This was turned over to the General Memorial Hospital in New York and the Howard A. Kelley Hospital in Baltimore. This amount is more than seven times as much as the total amount owned and in use in the United States before the work began. Meanwhile all the details for the treatment of carnotite ore were worked out and published for the benefit of the world at large. The Government radium plant was operated until January, 1917. The Bureau has retained enough of the output to enable it to carry out a number of scientific investigations in connections with radium.

Industrial Efficiency

American Workday in France.—The French press contains considerable comment of late upon the recent decision of a Lyons plant manufacturing machine tools to introduce, in agreement with its employees, what in France is called the American workday; that is to say, work will begin at 9 A. M. and continue until 5.50 P. M., with a pause of half an hour at noon. It is stated that this system, the introduction of which is contemplated in several Lyon industries, will immediately effect a considerable economy in light and fuel.

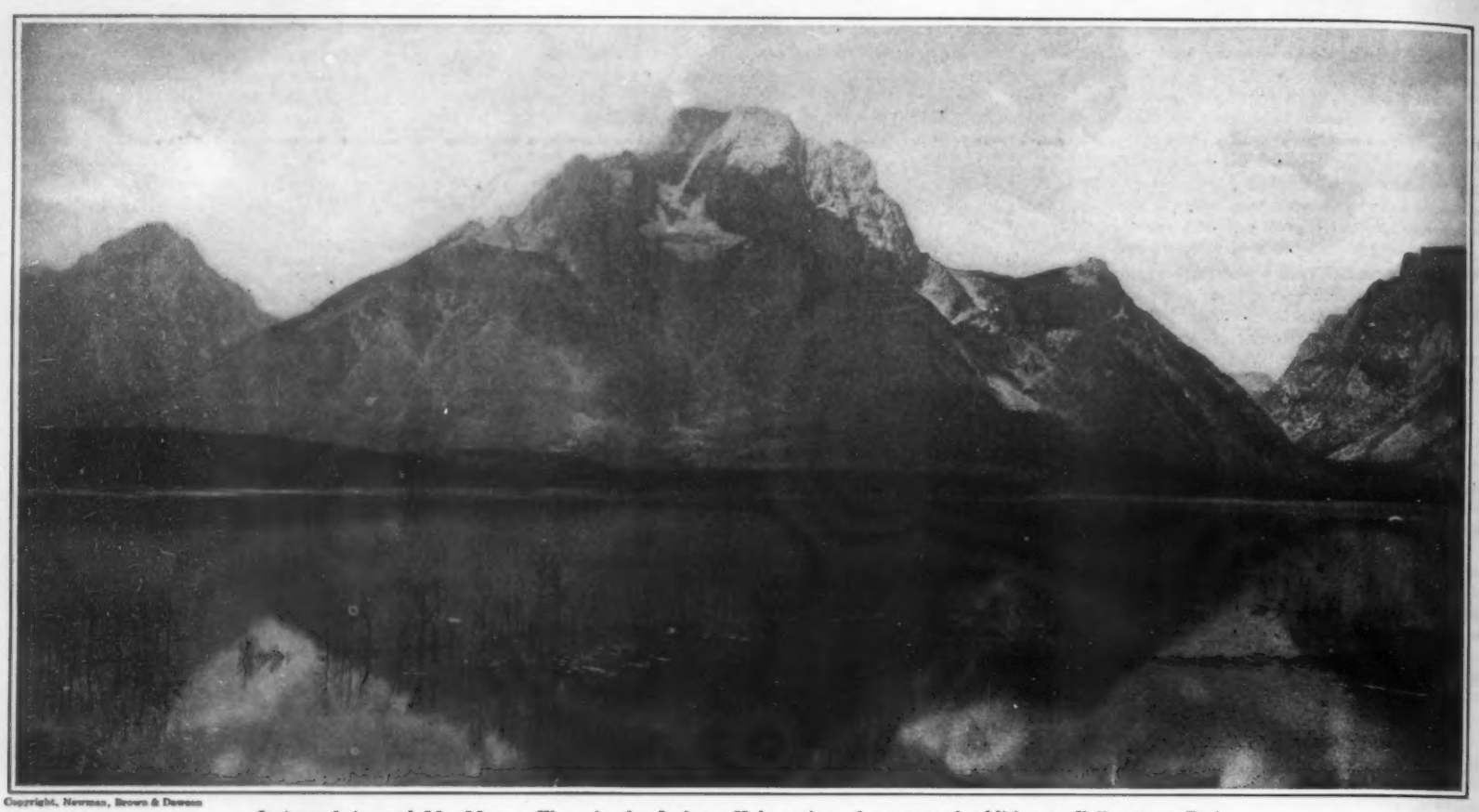
Inferiority of Present Coal.—Many complaints are being voiced these days with regard to the coal obtainable. "Run-of-mine" coal is expected to contain a small proportion of "bone" and slate, but the presence of such large quantities of unburnable material as are encountered in many a coal shipment today would under ordinary circumstances cause its immediate rejection. It is by no means uncommon for coal users to find large lumps and slate among their coal, in some cases measuring two feet or more. One coal purchaser found more than four tons of unburnable material in three carloads of coal. Owners of steam-operated plants have no recourse, however, and most consider themselves fortunate to obtain fuel even with this large proportion of waste.

Taking Care of Gas Lamps.—From a careful inspection of about 4,500 gas mantle lamps in service in ten cities a summary of the condition of mantles, glassware, pilot lights, and other particulars was made in order to determine to what extent the customer benefited through periodic maintenance service. By these observations it is found that a lamp not on regular maintenance is likely to be defective 5½ times as frequently as a lamp which is regularly maintained. Also it is shown that on the average 1 in 3 of the lamps on regular maintenance was not in good condition whereas the defects noted in the lamps not so maintained average more than one for every lamp. Technologic Paper No. 99, giving the details of the investigation, is now available for distribution and those interested may obtain a copy by addressing a request to the Bureau of Standards.

Soap from Dishwater and Table Refuse.—By installing a simple contrivance known as a grease trap in proximity to the different soldiers' messes, and by giving general instructions to the various camps and hospitals with regard to the saving and collection of table refuse, and even dishwater, the British military authorities are succeeding in collecting fats in quantities sufficient for the production of practically all the soap required by the army in Macedonia, and also of a considerable amount of dubbing and glycerine, the latter for the manufacture of ammunition. At present the monthly quantities required are as follows: Hard soap, about forty tons; soft soap, about ten tons; dubbing, about seven tons; glycerine, as much as possible. The quantity of fat required to produce this is, roughly fifty tons per month. This quantity has been easily obtained without depriving the men of their "dripping" and suet.

Safety Brake for Electric Tools.—In order that they may be capable of coping with the heaviest kind of work, electric tools are generally provided with powerful motors. As long as the work is satisfactory, no trouble is experienced; but once the bit or drill sticks or binds the powerful motor immediately causes the entire tool to revolve with oftentimes serious injury to the user. To overcome this danger a new safety brake has been recently introduced, according to *Safety*. This brake is composed of a special switch and connections including a small resistance. Its purpose is to shut off automatically the current and at the same time throw in the resistance in order to cause a powerful magnetic braking effect. When, for any reason, the operator's hand is removed from the handle, the brake stops the revolving tool in less than one revolution, thus rendering it harmless. The tool cannot become unmanageable, as immediately upon the release of the switch, either by the operator letting it go or the handle being jerked out of his hands, the device shuts off the current and stops the tool.

Less Lights and Less Coal.—Electric railroads throughout the country are to be complimented on their efforts to save coal by burning less lights, wherever and whenever it is possible without causing too great inconvenience to passengers. In the vicinity of New York City most electric railroads save on the average five lights to a car, which in the aggregate makes for a tremendous saving of fuel. In the case of the Hudson River tubes, a circular paster is placed near each empty receptacle, reading as follows: "Light reduced to save coal." On certain cars in New York City as well as on subway trains, experiments are being carried out with different lighting arrangements. Instead of the usual arrangement of lights over the seats, street cars are being arranged with a single row of lights running down the center of the car ceiling. Nitrogen filled lamps are being employed with proper shades and a considerable saving in current is being experienced. In the case of the subway trains, less lights are being used over the seats, and each unit is provided with an efficient shade.



Jackson Lake and Mt. Moran, Wyo., in the Jackson Hole region, the proposed addition to Yellowstone Park

The Jackson Hole Country of Wyoming

What the Proposed Addition to the Yellowstone Is Like

YELLOWSTONE PARK has always been one of the great sights of our West. Thousands of tourists visit its wonders every year, until today, there is no nook or corner of it that is not well known. Yet a short distance to the south there is a section of country that is almost unknown. With no reliable maps of its contour, it is a virgin field for the explorer, the naturalist and the camera man.

Jackson Lake, its largest body of water, lies about six thousand feet above sea level. From the shores rise the Grand Tetons, some of the peaks towering over fourteen thousand feet above sea level, many of them possessing glaciers that have never been conquered by man, and summits that are practically unscalable.

Game of all kinds is found within its virgin forests—bear, mountain sheep, deer, elk, and many other varieties. But unfortunately many of these animals have enjoyed the sanctity of Yellowstone Park, so that they are almost fearless of the occasional hunter seeking trophies for his rifle. To shoot some of these animals is little short of murder, for they still think that they are living under the sanctity of the Park. For this reason there is a bill before Congress adding this territory to Yellowstone Park, making it known under the name of the Greater Yellowstone.

The latter part of August 1917, Mr. Huntley Childs, President of Yellowstone Park System, with a party of writers and photographers, made an ascent of Mt. Moran to an altitude of 11,000 feet, for the purpose of exploring the glacier and obtaining photographs and motion pictures. The glacier was named by the party, after Mr. Childs, Huntley Glacier. The summit has never been attained and probably never will, as the last 3,000 feet of the mountain are sheer perpendicular walls of rock. But even at 11,000 feet one obtains a marvelous view embracing hundreds of square miles of lakes, mountains and plateaus, with the blue waters of Jackson Lake extending for 12 miles almost from one's feet. Nor are its broad vistas its only attraction; it presents ice caves and other glacial and geologic features of surpassing interest alike to layman and to scientists.

The Preservation of Steel in Concrete

THE preservation of iron and steel in concrete has been discussed widely but a new phase of the matter has recently been brought out by a British authority who states that the preservation of iron in concrete may be affected in any one of three ways: by the complete exclusion of air; by the complete exclusion of water; by rendering the concrete sufficiently alkaline. If the engineer can make his concrete conform perfectly to any one of these conditions he will achieve his purpose, for the reinforcing metal will not rust. Unfortunately in practice materials cannot be relied upon to yield perfect results, but by conforming as nearly as is reasonably possible to all three conditions he may hope so to reduce the tendency to corrosion as to render it negligibly small within finite time.

The following conditions were put forward as worthy of careful study. None of the concrete material should be too coarse, or thorough mixing and good contact between the different ingredients will not be perfect as is desirable. It is essential to press the mixture well into position to eliminate voids, which tend to increase permeability to water and are in consequence highly dangerous. The authority also stated that a sufficient thickness of concrete should be applied to the metal. If too thin, the concrete may not be sufficiently impervious, or may crack mechanically and thus admit water and air to the metal.

Stray electric currents must be avoided. Should the metal become anodic, rusting would take place in consequence of the liberation of oxygen, and this, leading to cracking, would rapidly destroy the cement. Substances likely to contain acids or acid-producing bodies, should be avoided. Coke breeze and slags are materials in point, as they frequently contain injurious sulfur compounds. The concrete may advantageously be coated with some waterproofing material to render it still more impervious, provided the proofing is entirely free from acids or acid-producing substances.

An ice-cave on Mt. Moran, 11,000 feet above sea level

The first party to explore Huntley glacier, high up in the Jackson Hole country

Our Shipping Problem

By Hudson Maxim

OUR shipping problem is one and inseparable with the U-boat problem. There is some difference of opinion among the authorities upon the subject regarding the degree of seriousness of the U-boat situation, but there is absolute unanimity of opinion that the situation is very serious.

In order to get to France the millions of men which we must send there, and to transport the necessary supplies for their maintenance, in time to save the situation, we shall require many millions more tons of shipping than are being produced by our present building program.

Consequently, it is of the utmost importance that we should avail ourselves of any promising means for protecting our shipping against torpedo attacks as well as that we should prosecute with the utmost vigor the campaign for the destruction of U-boats.

In the SCIENTIFIC AMERICAN of June 9th, 1917, was published an article in which was described and illustrated my method of protecting ships against torpedoes, as far as it had been developed.

The design described and illustrated in the present number of this paper embodies the essentials of the earlier design, together with substantial improvements. The present design is, in its main essentials, that which will be installed in one of the larger ships under construction by the Shipping Board.

In my earlier article above referred to, I explained the destructive action of the high-explosive blast of a torpedo upon the hull of a ship and also showed how the effect could be very greatly diminished by interposing in the path of the gases of explosion a barrier of water and a strong screen of steel rods, so that the water would be sprayed through the screen by the blast, the heat of the gases largely absorbed, and their velocity, volume and destructiveness correspondingly diminished. I also showed how the gases would at the same time be vented upward through the ship's deck into the atmosphere.

In the present design, in addition to the water barrier and the single steel screen of the earlier design, I employ a double screen, and also instead of thin steel plating of the all-steel ship of ordinary construction, I employ around that portion of the ship likely to be struck by a torpedo a belt of concrete in place of the thin skin plating. This concrete wall is provided with inwardly projecting webs forming chambers or spaces for holding the water of the water barrier and also for the upward venting of the gases. Through this concrete structure is run one of the screens of steel rods, making a very strong form of construction.

A series of vertical steel cylinders for carrying pulverized coal is placed just inship of the concrete wall, inseparably connected with and forming an integral part of the same. Through the center of the cylinders is run the second screen of steel rods which are welded to the walls of the cylinders where they pass through the same. The cylinders are welded together, all rivets are avoided, and all connections are made by welding, so that the entire system of cylinders is an integral part of the hull wall of the ship.

The outer walls of the cylinders are somewhat lighter than the inner walls, and the inner walls form a continuous, solid, integral, longitudinal wing-bulkhead of very great strength and stability. The size of the steel cylinders and the thickness of the hull wall will vary with the size of the ship on which the equipment is employed. On a ship of 9,000 to 10,000 tons burden the concrete hull wall will be from three and a half to four inches thick, of reinforced super-concrete, and the inwardly projecting concrete webs will be from an inch and a half to two inches thick.

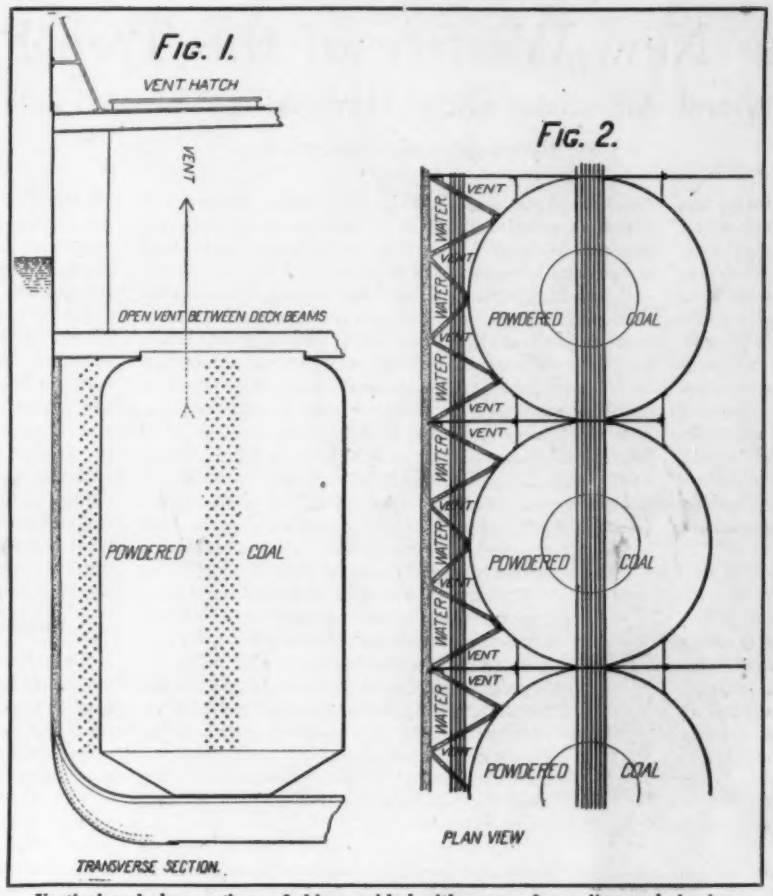
The concrete will be deposited, not by pouring, but by a blast of steam or hot air. This kind of concrete is much more dense, resistant and resilient than ordinary poured concrete. It possesses very much greater strength and is so dense that it is entirely impervious to water. It will take a polish like granite.

On a ship of such size the steel cylinders will be about ten feet in diameter and will hold about thirty tons of powdered coal each. The amount of water in the spaces of the water barrier involved in the direct path of an explosive blast will be about five tons. In addition to this water each of the cylinders will oppose to the blast 30 tons of powdered coal to receive, absorb and deaden the force of the blast.

Furthermore, the damage done to the hull wall of the steel ship of ordinary construction is very much greater than could be inflicted upon the concrete wall of this ship.

When a torpedo explodes against the side of the ordinary all-steel vessel, the thin hull wall is bent in by

(*Concluded on page 284*)



Vertical and plan sections of ship provided with means for cooling and slowing down the gases of torpedo explosion

Ingenious Ways of Destroying U-Boats

THESE are not happy days for the U-boats. Not only is the prey more elusive than in the halcyon days of 1915 and 1916 when merchantmen were unarmed and without convoy, but the U-boats are being actually pursued and destroyed even when seeking the seclusion of the ocean depths. So the U-boat has come to be the pursued just as much as the pursuer; and months hence it may be almost entirely the pursued, if Allied efforts are pushed still further; for we are told that the U-boats are now being destroyed as fast as they are constructed. When American destroyers and submarine chasers take to the seas in large numbers, when our building program in this direction is realized, then the doom of the U-boat will be effectively sealed.

Encounters with submarines are always interesting, especially if the censors permit them to be described in full. Recently, for instance, an American steamer had a brush with a U-boat which resulted in the probable destruction of the latter. It appears that the crew of the steamer saw a torpedo coming toward them, but there was not time enough to stop or alter the course. Fortunately, however, the torpedo missed; and the master of the steamer, with rare presence of mind, ordered the course to be shifted so as to follow the wake of the torpedo. Having gone but a short distance along the foamy path left by the torpedo, the steamer suddenly came up to the U-boat which was then rising to the surface, as depicted in our cover illustration. The submarine tried to avoid the blow, since it was too late to submerge. But the steamer's wheel was shifted, and it crashed full tilt into the U-boat. The badly battered hull of the German raider was seen to sink rapidly after that.

A more interesting case is that recently described by a writer in the Liverpool *Journal of Commerce*, as follows:

A seaplane had "spotted" a submarine lying on the sea bed. Instantly the observer's finger commenced to tap a key, and 10 miles away a long, lean destroyer and four squatty trawlers detached themselves from a pack of hounds working a covert and hastened to the kill. Meanwhile the seaplane circled around, but when the surface ships arrived her instructions, delivered by wireless, were curt and precise. Acting upon them the trawlers stationed themselves at the four corners of a wet quadrangle, while the destroyer kept her guns ready to talk to the enemy should he appear above the surface.

The trawlers at the corners of the quadrangle got out their sweeps—long wire hawsers of an incredible stoutness, with a heavy "kite" in the center to keep their bights down on the sea bed—and commenced to steam toward each other. As the pairs of vessels met, their wires simultaneously engaged themselves under the U-boat's bow and stern and commenced to work their sinuous way between her hull and the sea bottom.

Then the strange thing happened. Two round, black objects seemed to detach themselves from her hull and float surfaceward, to hover a second and then to commence bobbing down the tide—bobbing down a lane much frequented by those ships that brought food, munitions of war and hundreds of other things to England's shore.

"Mine layer, eh?" called the seaplane's observer.

"That's it, lad," came the telephoned answer, "but her eggs can wait for a minute."

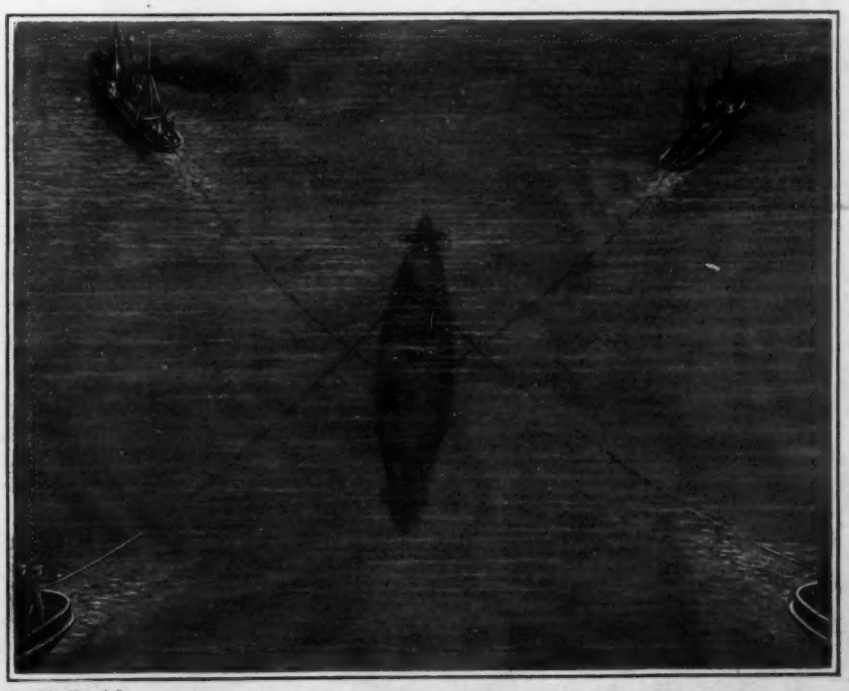
The trawlers now crossed their dependent cables and thus held the U-boat in a kind of cat's cradle. She seemed suddenly to wake up to her danger, for with a bound she tried to disengage herself from the meshes which held her. But it was no use; the trawlers had been too long at the game to leave any loop-holes and the submarine was doomed.

"Got him," signalled the seaplane.

"Thanks," replied the destroyer. "We'll give him five minutes to come up and breathe, but no longer." That time passed but still the submarine made no further move.

At a flagged signal from the destroyer the port foremost trawler and the starboard after one clipped a small red tin of high explosive to the bar-taught wire and allowed it to slide down till it touched the U-boat's hull. It was the seaplane's turn to wave a flag, and immediately there followed the crashing of two fists upon two firing keys; the uprising of two gray mounds of water and a rumbling, muffled explosion.

The seaplane circled twice above the patch of rising oil, ascertained that the German had been destroyed and notified the destroyer of the fact. Then, with her observer slipping a drum of cartridges into his machine gun, she sped on after those objects bobbing down the tide. A burst of rapid firing, and the first of the devil's eggs, its buoyancy chamber punctured, sank with a gurgle; the second gave a better show, for it exploded grandly and harmlessly as the bullets reached it.



Copyright, Munn & Co.

How the four trawlers succeeded in enmeshing the mine-laying submarine

The New Warfare of the Trenches

How Grenades and Automatic Rifles Have Altered French Infantry Tactics

By Austin C. Lescarboura

"Grenadier-fusilier" or rifle grenadier

"THE efficiency of our infantry has been increased five-fold," said a French general recently. And facts bear out his statement. When the French army, after almost four years of the hardest kind of fighting the world has ever known, and after sustaining losses of more than a million in killed and between two and three millions in maimed, wounded, missing and prisoners, can still bear the brunt of the fighting on the Western front, it is evident to all that the efficiency of the fighters must be high. Quality must make up for diminishing numbers.

There is no mystery connected with the efficiency of the French infantry. For ever since France entered the war her leaders and her soldiers have adapted themselves almost instantly to every change in this kaleidoscopic war. When the strategy suddenly changed from warfare of movement to that of trenches without flanks, they set to work devising ways and means of perfecting their defense while finding improved methods of attack. Which accounts in fair measure for a large and powerful army despite years of constant and heavy fighting with the inevitable losses incurred.

So peculiar is trench warfare that long ago the French authorities decided that there could no longer be such a thing as an all-around soldier. In other words, this kind of warfare calls for specialists. True, the plain infantryman could be called upon to perform a number of different tasks; but there must be some one thing that he knows better than any thing else. He must be a specialist, even if only in a small way. Working along these lines, the French soldier, after receiving his usual military training which in pre-war days was considered ample, now receives training in some specialized branch of the infantry service. He may be trained as a hand grenadier, sharpshooter, contact man, rifle grenadier, or automatic rifleman. Again, he may be trained as a shock trooper. In any event, he is not merely a plain soldier.

"Grenadier à main"—hand grenadier

Has the Grenade Replaced the Rifle?

Opinions differ as regards the hand and rifle grenade and the rifle. Some armies are inclined to stand by the rifle, while others, particularly the French, have partly discarded the rifle in favor of the two kinds of grenade. Be that as it may, the fact remains that the grenade has proved a most effective weapon in this war of trenches, both for offensive and defensive operations.

Most assuredly, there is nothing new in using the grenade. This practice dates back to medieval times; indeed, with the introduction of the firearm the grenade was largely replaced by what was considered a more effective weapon. Just at the time when the hand grenade was considered as an obsolete fighting tool of bygone days, it cropped up on the plains of Manchuria in the Russo-Japanese war. In the Balkan war it was widely employed; but it remained for the present trench warfare to reintroduce the hand grenade on an extensive scale. The first grenades used by the French and British were merely discarded tin cans filled with high explosive and iron slugs, and provided with a Bickford cord which was lighted from the cigarette of the grenadier. From such crude beginnings were evolved the elaborate offensive and defensive grenades of the present.

Grenades fall into two broad classes: offensive and defensive. The former are those employed in offensive operations and are meant to be thrown a short distance and to explode without injuring the exposed grenadier. Thus the offensive type of grenade must have an intensely localized explosion, and the majority of them have an extreme killing or maiming range of twenty-five to thirty feet. The defensive grenades, on the other hand, are designed so as to burst into a large number of pieces and cover a wide range, since the grenadier in this case is sheltered in a trench or shell hole and cannot be injured by the widely-flung fragments. So grenades for defensive purposes have an effective range of 300 feet, and are only thrown from well protected positions.

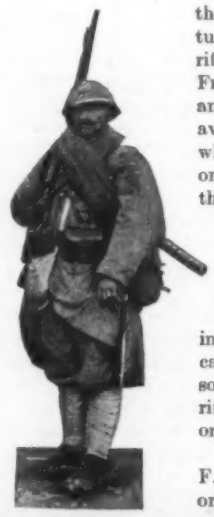
How to Train For the Bombing Squad

The flinging of hand grenades is no sinecure. It is more that merely pitching or tossing a missile. In truth, the bombing schools at the front and behind the front are sufficient proof that grenadiers are not born: they are made as a result of long and intense training. And a grenadier has to keep in constant practice, just as the baseball player must keep in trim during idle seasons. Constant practice results in the hand grenadiers acquiring marvelous skill, which is amply reflected in long throws and in great precision of aim.

A bombing squad in the French army consists of a corporal and seven privates—two grenadiers, two grenade carriers, two sharpshooters or skilled fighters, and a grenadier in reserve. All the members of a bombing squad are capable of doing the work of any other member, for the same general course of instructions has been given to each. Every man must be able to execute a grenade barrage at 80 feet distant to qualify for bombing work, so that it is at once apparent that they must be skilled in a general way. However, the grenadiers of the squad have been selected as being the most adept, and have received, in consequence, a more thorough course in grenade tossing.

The sharpshooters of the bombing squad are expert infantrymen assigned to this special service. They are known as *voltigeurs*. Their qualifications are, first, great skill with the bayonet; secondly, accurate and rapid marksmanship; thirdly, great agility and redoubtable courage. Theirs is a duty of guarding the grenadiers preoccupied with their bombing activities, and at all times the sharpshooters flank the bombers and protect them against counterattacks.

Why must the *voltigeurs* be agile? Well, in an attack on enemy positions these members of the bombing party lead the way through the trenches with fixed bayonet, ready to slash, crush, stab, jab or shoot any enemy encountered. They dash ahead of the grenadiers, following all the ins-and-outs of the trenches and communication trenches. Counterattacks by the enemy are immediately discouraged by the *voltigeurs*, for these are more than ordinary soldiers and are quite capable of handling far greater numbers of opponents. And that is not all; the agile *voltigeurs*, intrepid as they are, act in the capacity of observers, reporting to the grenadiers back of them where the grenades are falling. They act as scouts, informing those behind when to halt and when to advance. At the cry of "*Nettoyé!*" the squad advances, having "cleaned" a stubborn enemy bomb-proof or dugout or trench section. Finally, when the advance has reached the limit of safety, the *voltigeurs*, handimen that they are, pile up sandbags and in other ways proceed to consolidate captured positions either for a prolonged defense or to serve as a rear guard barricade.



Assault equipment of infantryman

The grenade carriers are the supply train of the bombing squad. They carry the grenades in baskets fastened to belts, and see to it that the grenadiers are kept supplied with deadly missiles.

The grenadier in reserve is a contact or *liaison* man as well. His duties are to act as courier or "linking" man between the little group and the base, informing the officers at the rear when the grenades are running short and always ready to replace either grenadier or carrier when the fortunes of war so dictate.

Skilled, well trained and organized, interchangeable, the bombing squads of the French army go about their work with clocklike precision. At the battle of Mont Cornillet, for instance, such squads were in the thick of the fighting and contributed materially to the breakdown of the German defense.

Using a Rifle for Throwing Grenades Farther

When thrown by hand the grenade, perforce, has a limited range. No lesser authority than Lieut. Hebert, in charge of French bombing schools and constantly in search of the "aces" of bombing, states that commendable ranges of over two hundred feet have been achieved by expert grenadiers with grenades weighing 1.2 pounds. But these are exceptional cases; for the average bomber a range of 120 feet is considered quite satisfactory under fire and in the excitement of battle.

It was in order to increase the range of grenades that the rifle grenade was introduced. The French make use of a special rifle-grenade holder which can be attached to the muzzle of the infantry rifle without causing undue inconvenience or adding much extra weight to the latter. In fact, it weighs just about three pounds, and is arranged to take a special form of grenade. The Viven-Bessieres or V. B. adaptor permits the usual bullet to pass through its center and unlock the safety device of the grenade, which an instant later is hurled through the air by the usual gases from the cartridge. A distance of about six hundred feet can be attained with a rifle grenade of this kind.

While it is possible to fire the grenade rifle from the shoulder, it is better to rest it on the ground. In fact, the French rifle grenadiers generally prefer to hold the gun in some form of wooden framework because of the greater accuracy of aim and the complete absence of discomfort. As for the grenades, they weigh so little and take up such small space that the rifle grenadier can carry an ample supply, depending on the usual grenade carriers for more.

"Voltigeur," or rifleman of bombing squad

Machine Guns That Are Worked Like Rifles

The recent demonstrations of the new Browning automatic rifle lend particular interest to a weapon of similar type long employed in the French army. For there is no doubt that our American forces, trained by French officers, will soon be using the Browning gun in the same manner that our allies employ their automatic rifle.

The French automatic rifle weighs almost twenty pounds, but is still not too heavy to use as a shoulder piece. This weapon has succeeded in relegating the usual machine gun to the realm of defensive operations; for why move a heavy gun forward over fire-swept terrain when a much lighter and just as efficient weapon is available? So the machine gun remains in permanent positions while the automatic rifle moves up with the attackers.

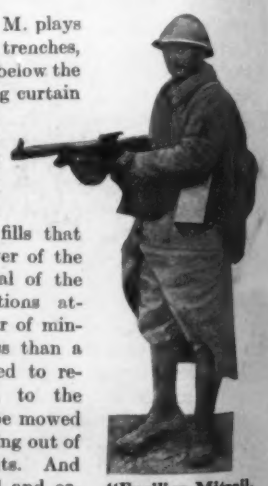
Because of its nature the automatic rifle is less cumbersome to handle than the usual rifle. At short ranges its efficacy is absolute, since the fire is automatic yet slow as machine guns go, and the chances of hitting the mark are far greater than with an ordinary rifle in the hands of an infantryman excited at the turn of events. Furthermore, the automatic rifle or *fusil-mitrailleur* as it is known in French, is generally fired from the hip during an advance, and aimed rather low so as to avoid overshooting the mark. The cartridges, which are carried in a semi-circular magazine on the under side of the barrel, just forward of the trigger, can be fired in a string or separately, as circumstances dictate.

Owing to the rather cumbersome appearance of the automatic rifle, the French at first were tempted to call the handlers of these weapons the "musketeers" of the infantry, who were trained at the "musketeer's camp." But this old-time fighting term was soon dropped, and at present the automatic rifle-men are known as *fusilier-mitrailleur*, or F. M. for short.

As in the case of the rifle grenadier, the F. M. can use his weapon while on the march or by resting it on the ground; in the latter case he uses it much after the fashion of the machine gun. However, the weapon does not possess the rigidity and the rapidity of fire of the machine gun, for it must be borne in mind that it is intended to serve an entirely different function. Its rate of fire varies from sixty to eighty shots per minute when fired singly, and 140 shots per minute when fired in a string.

During an attack the F. M. plays his weapon on the enemy trenches, thus keeping the defenders below the parapet even after the rolling curtain fire has passed over, and in this manner giving the bombers an opportunity of reaching the positions in comparative safety. In brief, the automatic rifle fills that gap between the rolling over of the barrage fire and the arrival of the infantrymen at the positions attacked. Although a matter of minutes and in most cases less than a minute, this gap, if allowed to remain, might prove fatal to the attackers who would then be mowed down by the defenders coming out of their trenches and dugouts. And once a position is captured and organized, the automatic rifle aids in

(Concluded on page 286)



"Fusilier-Mitrailleur" or automatic rifleman

War and Money

How the Engineer, Scientist and Inventor Can Best Help to Win the War

By Hudson Maxim

IN olden times, when men fought with swords and clubs and spears, war was a very simple proposition. It was one mainly of sheer brute force and the power of numbers. Fighting then was done largely by hand. There was little employment of labor-saving machinery or labor-saving fighting mechanism. The same thing was true with regard to the industry and agriculture of the time.

But the modern inventor, scientist and engineer has changed all this, and in modern factories and on the farms a few operatives with labor-saving machinery are able to do the work of thousands.

The same thing holds true in modern warfare. War today is an engineering proposition, an industrial proposition and a financial proposition. Ten times as much must now be done on the farms and in the factories to win a war as is done on the firing line.

In order to supply a million men on the firing line with munitions of war—food, clothing, guns, ammunition—ten million operatives must work on the farms and in the factories and in the work of transportation.

Consequently, the greatest opportunities are offered inventors, scientists and engineers to help win the war, first in the production of munitions of war, second in their transportation, and third in devising means for their fullest utilization on the fighting front. But how can inventors, scientists and engineers help in the production of agricultural products? It is more obvious how they may help in the production of weapons, ammunition and machinery and in actual campaigning. Nevertheless, it is a fact that at the present time there is no place where creative genius is more needed or as much needed as in the scientific production and utilization of food; and the thing of next importance is to get the food over the seas without being sunk by torpedoes.

During the past year the German U-boats have succeeded in sinking Allied shipping at a rate equal in value to $6,000 a minute, $8,640,000 a day, $259,200,000 a month, $3,100,400,000 a year. Money to make up this loss must come from the people, and it must be lent to the Government.

The necessity of devising effective means for combating the U-boat is obvious. Such means have been devised and are now being largely employed, but to carry on the campaign against the U-boats money must be supplied. Immense sums of money are required for the development of naval and military inventions and for conducting the necessary experiments to determine their value. Above all, the actual campaigning, where they are used in service, is exceedingly costly.

It is a fundamental principle of warfare that there must be maintained an open and adequate line of communications between an army and its base of supplies. The line of communications between our army in France and its base of supplies is more than three thousand miles long, over the stormy Atlantic, infested with U-boats.

We must build ships enough to supply not only the places of those that may be sunk, but also the additional ships that may be needed for the requirements of our ever-increasing over-seas army. This will need millions—yes, billions of money, and that money must be supplied by the people.

We must win this war, or free institutions will perish and universal feudalism and serfdom will replace world democracy.

We must prepare to make any sacrifice needed to meet our obligations. "All that a man hath will he give for his life." We home stayers who are not offering our lives should freely give the Government the use of our money, when so many of our fellowcountrymen are staking their lives for liberty on the fighting front. Let us then stake the government with our money.

It has been facetiously said that the three main essentials in the conduct of modern warfare are, first, money; second, more money; and, third, still more money.

Mail Through the Air

The Significance of the New York-Washington Undertaking

SINCE 1908, when Orville Wright first demonstrated to an incredulous world that a heavier than air contrivance of canvas, wood and gasoline engine could actually fly, enthusiasts over the new art have railed at the United States government for its supine attitude regarding the development of what appeared to be the most revolutionary discovery in transportation since steam was first applied to stage coaches.

And for eight years, indeed, the government took but little interest in aviation, appropriated for it most meagerly and encouraged its commercial development not at all. For this neglect it paid dearly enough when war brought the need for a great aerial program.

But there have always been some government officials who kept alive the hope that some day the power of the nation would be officially directed to the development of aviation. That day came, not when Congress appropriated $640,000,000 for battle planes and aviators for foreign service, but when the war developed aviation sufficiently to enable professional aeronauts and manufacturers to assure the Postmaster General that an aerial mail route was at least not an impossibility.

It is now about to become a fact. A daily mail service between New York City, Philadelphia and Washington is to be established as soon as the postal authorities can get machines built under bids or obtain them from the War Department—which method will be used is not yet quite decided.

It appears that the difficulties in the way are no longer those bound up in engine, plane, strut or fuel—that neither distance, air current, prevailing wind nor landing ground offer insuperable difficulties. The lions in the path of him who would fly with a mail sack from capital to metropolis are meteorological beasts, and until they have been met and slain no man may say whether or not the service will be a success. With all else provided in perfection, there yet remains the matter of fog.

Imponderable in itself, it may be the one bar to the successful establishment of the service. An airplane which cannot find its landing grounds is the most helpless thing imaginable. It can stay aloft only so long as its fuel holds out, after which it must come down. If it can find no proper place to land, disaster is the inevitable end of the flight. Whether mail planes can find their landing places in the winter fogs which do so frequently encompass New York harbor is something which only the first fog and the first aviator to test it can say.

With ample funds, appropriated by Congress for the purpose, the Post Office Department begins the establishment of a mail service *via* plane with every prospect of success in every way except the one unknown factor of weather. It is pointed out that no service which is occasional or intermittent in character will be regarded as satisfactory. Airplane mail will be decidedly more expensive to send than ordinary mail, and those who use it may have to pay as high as 24 cents an ounce for the privilege in addition to the regular 3 cents, although no definite rate of postage can be established until some months experience have demonstrated the running cost of the service. The Post Office will not be willing to make a high charge for the privilege of sending mail from city to city in a few hours and then not "make good" on the delivery.

Every provision will be made for the inevitable interruptions incident to any transportation system. Railroad trains break down, ship boilers have been known to blow up, mail carriers have died of heart failure on their routes. And airplanes may be expected to develop engine trouble and descend in corn fields or marshes or rivers. But the air route from Washington to New York lies over a very thickly populated section and no such untoward happening would be apt to escape unnoticed. A telephone message to the nearest Post Office would bring help instantly, and the mail, somewhat delayed, but still within the same day, would be delivered either by automobile or train or both.

Automobile trucks will be a part of the service, stationed at both terminals and at Philadelphia, and if the necessity is found to exist, a mail relief truck will be stationed in half a dozen other cities *en route*.

The Postal authorities are not considering the establishment of this service by contract, except a contract for the purchase of the necessary machines, of which at least five and perhaps more will form the nucleus of Uncle Sam's Special Delivery Aerial Mail Fleet. The Air Mail Service will be entirely a government service, and the pilots, helpers, mechanics, hangar men, etc., will all be postal employees.

Some criticism, entirely unjust, has been leveled at the Department for attempting to start this service at this time, when, according to the critics, every man and every plane which can be built in America is sadly needed over the firing lines in France.

To begin with, the kind of plane to be used for mail service would be of as much use in France as a row boat in chasing submarines. The mail planes will not be fast planes, using the word as a battle-plane pilot uses it. Something less than a hundred miles an hour will be their speed. As for the men who will fly them, there are a great many young men anxious to serve Uncle Sam as birdmen whom Uncle Sam won't have for one reason or another. Many of the factors which disqualify a man for military aviation do nothing to unfit him for postal work, and undoubtedly it will be from such ranks that the Post Office will draw its aerial recruits.

Moreover, the establishment of an aerial mail service, even should it take planes which could be used in France, and men who could serve over the trenches, might yet be a most valuable war factor in the stimulation of production. While the government is encouraging the production of planes in every possible way, even to the financing of manufacturers who have the ability but not the capital to expand to the needed war program extent, it cannot wholly overcome the native caution of the far sighted business man. No capitalist is going to build a huge industry involving the expenditure of an immense amount of money, without some reasonable assurance that that capital will earn interest for a sufficient length of time to make the investment attractive.

At the close of the war—should it, perhaps, come within a few months or a year—America may be left with an immense force of plane builders, factories, and half molded material, and with no purchasing power to turn such resources into money. The development of peace uses for aerial transportation is a problem of great magnitude, and the establishment, not only of one mail line via plane but of many such, is a matter of vital interest to the commercial side of aeronautics.

From the scientific standpoint, the proposal to establish a day-in-day-out service, in which planes will attempt a 200-mile run twice every 24 hours without reference to weather, holds much of interest and should result, whether successful or not, in a vast increase of knowledge both aeronautical and meteorological. While daring aviators fly today when military necessity commands, with little regard for the winds that blow, aerial work is still to some extent circumscribed in effect by storm, cloud, fog and the rather broad latitude which meteorological prediction yet demands. Just how much progress in the art of flight, as well as in the science of weather prediction, will result from an attempt daily to negotiate a definite distance without reference to the prevailing temperature, pressure, wind velocity, atmosphere, cloud and precipitation no one can say but certainly the experiment promises much.

With no knowledge of what the experiment will cost to maintain for any given period, the Post Office Department is quite willing to go ahead. If the experiment succeeds, it will be worth whatever it costs, and if it fails, it will still be a paying investment. If the experiment succeeds, it will open up a new avenue of usefulness to that function of the government on which the entire business fabric of the most business-like nation in the world has been built. The Post Office Department has invariably been willing to run a new postal departure at a loss, if it paid in the service rendered. Rural Free Delivery is a case in point, as indeed, are many mail deliveries to distant points. If the experiment fails, between two close-to centers, over thickly populated territory, and in latitudes where the weather, if occasionally trying, is not normally subject to such tremendous disturbances as other parts of the country have to endure, it will pay to know it before making plans to enlarge the postal facilities between other commercial centers on the airplane plan.

But the postal authorities are convinced that the experiment will succeed. The Second Assistant Postmaster General, Mr. Otto Praeger, who has the matter in charge, believes that while difficulties and obstructions will be encountered, they will be surmounted, and that the resources of the Department, plus the cooperation of both manufacturers and the War Department, will succeed in overcoming any handicap the weather gods can place on the aerial mail service. He expects that mails closing at 11 o'clock in the morning in Washington and New York will be delivered in New York and Washington shortly after 2 P. M., day in and day out, from the establishment of the service until the interval necessary for transit is diminished.

Mechanical Equipment of the Farm

Latest developments in agricultural machinery and practical suggestions for the farmer

Conducted by HARRY C. RAMSOWER, Professor of Agricultural Engineering, Ohio State University

Fig. 1 An uprooted stump showing the power of a capstan puller

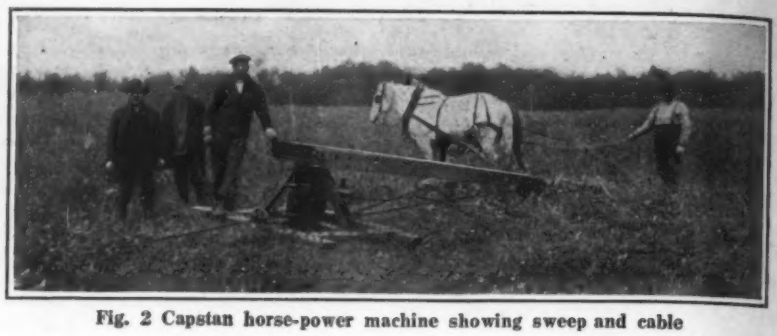


Fig. 2 Capstan horse-power machine showing sweep and cable

Equipment for Pulling Stumps

HIGH prices for farm products have stimulated interest in clearing lands rendered uncultivable by stumps and brush. In almost every state in the Union there are thousands of acres of such land which, when cleared, will yield its full quota of farm crops. In many cases the work of clearing has been delayed through lack of knowledge of stump-pulling equipment.

Dynamite or some other form of explosive has been resorted to as a means of uprooting stumps and is without doubt responsible for the clearing of large areas of land in various parts of the United States. Explosives, however, are not always successful in completely removing the stump from the ground. Their use, therefore, must generally be accompanied by some type of stump puller.

Where only small areas are to be cleared of occasional stumps, or in swampy places where it is impossible to use horses, some form of hand-power puller is desirable. One such type is shown in Fig. 4. This machine consists essentially of a lever which operates in much the same manner as on ordinary fence-stretching machine. By engaging a series of grips, a small force applied at the end of the long lever exerts a tremendous force, which tends to shorten the cable between the stumps. This tool is most effective in pulling stumps cracked by dynamite, small stumps, or large stumps in swampy lands.

A capstan horse-power puller is shown in Fig. 2. This is a very powerful machine and is, perhaps, the most popular stump puller in use. With a cable 200 feet long it is possible to clear a very large area of land at one setting of the machine. Work with this machine can proceed rapidly, as it takes but a relatively short time to remove the cable from the pulled stump and attach it to another. Power pulleys are supplied with this machine when necessary to pull extremely large stumps.

Figure 1 shows a capstan puller in operation. The immense size of the stump uprooted is an indication of the great power of this machine. The large amount of earth clinging to the stump is evidence of the fact that after the stump is pulled a great deal of work remains to be done before the stump is finally burned.

It is estimated that 40 per cent of the work of ridding land of stumps consists of piling and burning. A simple homemade contrivance for piling by means of horse-power is shown in Fig. 3. The tripod and gin pole are mounted on skids so as to be easily and quickly moved. With a cable of some length a large pile can be made in a very short time.

Fig. 3 Home-made stump piler using horse-power to handle the stumps

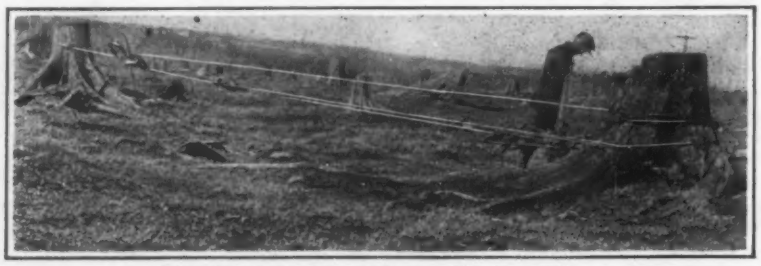


Fig. 4 A hand-power stump puller in service

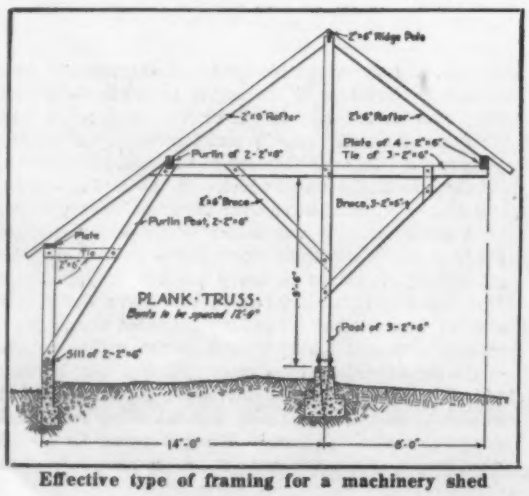
Storage of Farm Machinery

By F. W. Ives

IN our efforts to "speed up" and "conserve man power," we sometimes overlook many of the economies which, though small, collectively amount to a great deal. The unnecessary handling of farm machinery in storage and the losses attendant upon non-storage are two items not generally considered as being worth taking into account; yet they may amount to several hundred dollars annually even on a farm of moderate size. The advent of the tractor and the heavier and more expensive equipment required, makes the factor of depreciation resultant from non-storage a serious one indeed, since this item frequently totals as high as 20 per cent per annum of the replacement value of the equipment.

Farm implements and machinery are frequently stored in unhandy, poorly lighted and inconvenient quarters merely because the space is available and irrespective of the fact that the time spent in getting a given piece of apparatus out of storage and into service frequently costs enough in one season in man and horse hours to pay the interest on an investment in a good machinery shed. Or if, as is the case frequently, the machinery is stored on a barn floor, it must be taken out in the weather during haying and harvest seasons. In case of fire, machinery thus stored is lost, while had it been in separate storage it might have been spared and much time saved.

A long narrow machinery shed, open or with doors on one long side, seems to be the ideal storage house for implements. Machinery may be stored in sections, according to seasonal use, thus avoiding much unnecessary handling. For example, haying machinery may be placed in one section, tillage tools in another and seeding machinery in still another. A drive-through arrangement is very convenient for vehicles, manure spreaders, tractors and other pieces in fairly constant use. This arrangement, however, requires a considerable area for drives. A simple inexpensive machinery shed may be constructed in bents, as shown in the accompanying figure. These bents are plank trusses of cantilever type very strong and simply constructed. The width, 22 feet, is almost ideal for the storage of implements found on the average farm. The length may be increased in multiples of 12 feet according to the size of the farm and method of farming. The roof is preferably covered with some fire-proof or fire-resisting material, as this practically eliminates fire hazard for this class of building. A concrete floor makes for ease in shifting machinery and also protects metal wheels from contact with the earth. A clay floor well tamped and oiled is a most excellent substitute.



Effective type of framing for a machinery shed

A Drive on Grain Elevators

THE Pacific Northwestern States region will make an effort to build this year 400 grain elevators in Washington, Oregon, Idaho, and Montana. This has always been a sacked grain region—that is, wheat and other cereals have been marketed in bags instead of by the cheaper bulk method through grain elevators, common in Eastern and Middle Western States. At the recent meeting of the Farmers' Educational and Coöperative Union of America at Spokane, a committee on bulk handling of grain made an elaborate report, showing that bags may not be available this year at any price, and urging State agricultural colleges, county demonstration agents, bankers, railroads, business men, and farmers to combine on a program for the building of elevators. Coöperative companies of farmers can build elevators in some cases and business men will be able to finance elevators in others. Emphasis was put upon standard construction under competent engineering supervision, and the provision of ample facilities, with grain cleaning machinery and other modern devices.

A Rat Census

SOME interesting figures about the rat population of Kansas have been compiled for the Federal food administrator of that state. Working with figures of European rat surveys made just before the war, it is estimated that the rat population of a city like Wichita is probably equal to the human population, while in the country districts there are at least 10 rats for every person. A fair estimate would give 3,000,000 rats for Kansas, each requiring $2 worth of food a year, a $6,000,000 loss. Practically all the rats in Kansas, however, would have to work one year to effect the destruction represented by the careless handling of eggs in that State, for it is estimated that careless handling, storing, and shipping cause the destruction of one-fourth of the State's total egg output for a loss of $5,000,000.

Kill Antisugar-Beet Propaganda

A VERY definite and insidious propaganda against the growing of sugar beets is now showing its effect in our Western States and Federal food administrators in the States and counties where sugar beets are grown may well be on the lookout for this propaganda and be prompt in killing it. The general effort is to discourage the beet farmer and reduce acreage, chiefly by predicting unprofitable prices for sugar next fall. Any reduction in our sugar beet acreage would serve two purposes for Germany—first, a direct shrinkage in this war-time crop; second, the crippling of our industry for the advantage of German beet sugar. Since the war we have made this country independent of Germans for sugar beet seed, replacing inferior Russian strains formerly sold us by Germany with pedigreed seed of our own breeding. We must make our country as nearly independent of outside sources of sugar supply as possible.

Copyright, International Film Service

Centrifugal gun which is claimed to fire 33,000 shots a minute or 555 a second

Is This the Solution of the Centrifugal Gun Problem?

EVERY so often the daily press becomes enthused over a new centrifugal gun. Twirled by electric or other power, the powderless weapon is said to throw a veritable spray of missiles with considerable penetrating power and fair accuracy. Already the conventional types of firearms and artillery are considered doomed.

Yet nothing ever comes of any of the numerous centrifugal guns. They are announced and then forgotten. That is why the centrifugal gun is the classic joke of ordnance experts, who, knowing the many difficulties in the way of producing a practical weapon of this kind, do not consider it seriously.

Just now it is the centrifugal gun of Levi W. Lombard of Boston, Mass., which is attracting public attention. This weapon, which is driven by an electric motor, is said to shoot 33,000 round steel missiles a minute, or 555 a second. At present the inventor is not in a position to give details concerning his gun, except to state that it operates on the principle of the sling. Each bullet is twirled on a disk at a great rate of speed and then released. The ammunition is fed through a funnel-like arrangement leading into two "veins" which center upon an opening through which the missiles are hurled with great velocity.

In a recent test, the inventor claims, the gun was turned on to sheets of ¾-inch steel several hundred feet away. The bullets whipped through the steel as if it were paper. The missiles are small steel balls similar to ball bearings. It seems that the weapon, if really practical, could be used in defending trenches against massed attacks, in which case it could be placed on the parapet and operated from a distance.

Special Machine-Gun Bullets for Aerial Combat

THE recent announcement of the War Department to the effect that the ordnance bureau has developed bullets of three distinct types for use of airplane fighters, lends particular interest to the accompanying drawing of the special bullets employed by enemy airmen.

With the introduction of the armored or partly armored airplane, it has become necessary to introduce the armor-piercing bullet. In the case of the German bullet for this purpose, it will be noted that the projectile consists of a German silver jacket to take the rifling of the gun barrel, with a core of steel. Obviously, such a bullet has great piercing powers, and it is reported that the German airmen make particular efforts to disable the engine of their opponent with this type of missile.

The gasoline tank being the most vulnerable member of the airplane, especially if it can be set aflame, special incendiary bullets have been developed for the aerial fighters. The German incendiary or tracing bullet is hollow, and contains an incendiary matter of a phosphor base. It leaves in its wake a luminous and smoky train, destined to ignite balloons and gasoline tanks and to permit the gunner to rectify his fire. Even in total darkness, the gunner can follow the trajectory of the incendiary or tracer bullet by means of the bright spark, while in daylight he observes the smoky wake.

Explosive bullets of the type shown are intended for all around purposes. Indeed, they are very much in the nature of a small shell, containing a small plunger forming a percussion firing pin over a detonating primer. It is said that this type of bullet is carried in belts and drums in the proportion of about ten to fifteen per one hundred, in German fighting planes.

Our Army's Artillery Against Disease

STRANGE as it may seem, in past wars more lives have been lost through disease than through wounds. This fact was clearly brought out in an interview with the Surgeon-General of the British army, published recently. Again, in our own Spanish-American war the loss through disease was many times greater than the loss in battle. In the present war, particularly on the Eastern and Balkan fronts, deaths attributable to disease and particularly typhus have been many times in excess of the losses through wounds.

The Medical Department of our Army early determined that this useless loss of life must not occur. Steps were taken even at the time of our Mexican trouble to

These special machine-gun cartridges are employed by German airmen

prevent typhus gaining a foothold in this country, for it already existed across the border. At the time the Red Cross went into Serbia, Dr. Leon L. Watters of New York City was called upon to devise an apparatus for the purpose of combating this disease; but by the time the apparatus which he designed reached Serbia, the country was overrun by the Austrians and over $40,000 worth of the apparatus was captured by them.

Long before we entered the war, Colonel F. M. Hartsock of the Medical Department, U. S. A., arranged with Dr. Watters to construct ten pieces of apparatus which were sent to the border; and as a result of the Army's experience with this equipment, Colonel Hartsock designed, in coöperation with Dr. Watters, an improved portable type of sterilizer of which type 50 are now being constructed.

The new sterilizers are said to be the largest pieces of sterilizing apparatus ever constructed. Each one weighs nearly eight thousand pounds and is drawn either by four horses or by an automobile tractor, since it is permanently mounted on four steel wheels. Complete in itself, the new sterilizer consists of a steam boiler which provides the necessary high-pressure steam, and a steel chamber in which clothes, blankets and other articles to be sterilized are placed. The steam boiler, which is of the upright type, can be fired with coal or wood, or for that matter with any other fuel that may be available. The steam

Copyright, International Film Service

Looking down the funnel-like hopper into which the bullets are fed in bulk

chamber, it will be noted in the illustrations, is provided with a heavy door carrying a large number of radiating locking bolts; in fact, it is strongly suggestive of a vault door, with a center wheel operating the bolts. A davit to one side supports the door when it is moved out of the way, there being no hinges. The articles to be treated are placed in a wire basket which is slidably mounted on tracks. Because of its portability, it is believed that the sterilizer can be drawn up as close as desired to the front line.

Typhus, as is well known, is carried by body lice and vermin, which the soldiers designate as "cooties"; and in spite of all precautions, it is impossible to free the men from these pests. By the use of these disinfectors, however, it is possible to take the men out of the trenches and send them to one of the many stations where facilities are provided for thorough bathing and cleansing of their bodies, while their clothing and effects are being thoroughly disinfected in less than 40 minutes. It is said that the new sterilizers will handle the effects of about forty men at a time.

It is expected that the apparatus which is now being sent to France will provide also the means for overcoming the difficulty now existing on account of lack of facilities for sterilizing the vast quantities of surgical dressings required. After considerable study, tests were recently made by Colonel Edward N. Vedder of the Surgeon-General Office, who demonstrated that this apparatus is capable of rendering sterile the gauze, cotton bandages, surgeons' gowns and other materials required in operative work. As a result, the Army will have available means for providing a constant and plentiful supply of these articles.

Putting Fires Out Before They Get Started

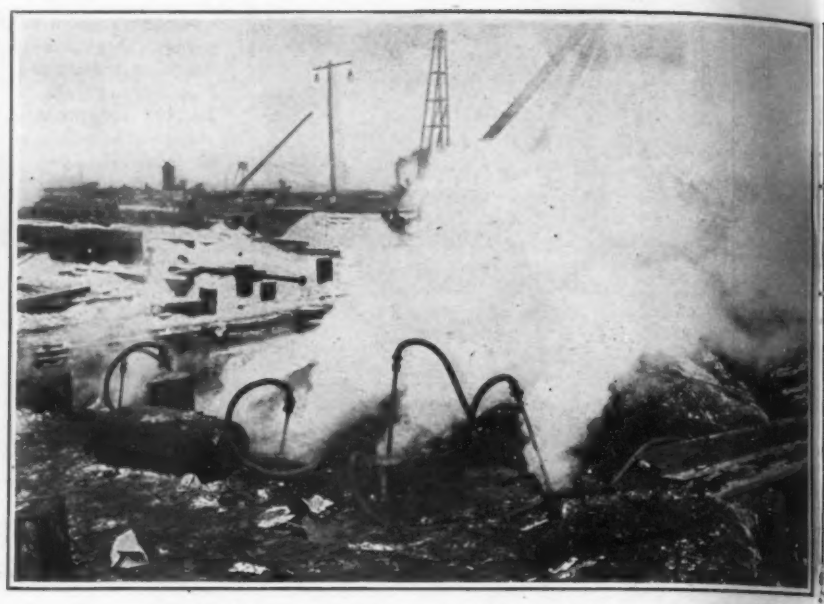
PROMPTNESS on the part of the employees of the Pennsylvania Railroad system in extinguishing fires before the arrival of the public fire companies last year saved $10,445,196 worth of company property from destruction. Altogether 334 fires were put out by employees without outside aid. These occurred on property valued at $10,457,774, but the total loss sustained was only $12,575.

This illustrates clearly the value of thoroughly training employees in fire-fighting methods, or organizing fire brigades, and of providing modern fire extinguishing apparatus at many points. The regularly organized fire brigades, chemical extinguishers, locomotive fire apparatus, water casks and fire pails, fire hose, high pressure lines, chemical engines, sand pails, extinguishers and tug boats were utilized in one place or another in putting out these fires. Moreover, by following the general instructions given in fire-fighting methods, employees of the company, extinguished 107 fires without the aid of any apparatus at all, for a total loss of $2,064, on property valued at $355,590.

Opening the heavy door of the steam chamber — Sterilizer ready for transportation — Side view of apparatus, with wire basket at right

One of the many sterilizing plants now being constructed for our Army in France as a protection against disease

Hog Island in its original state. Running a survey through the brush



Thawing the ground with live steam before driving piles

Ship Builder Versus Submarine

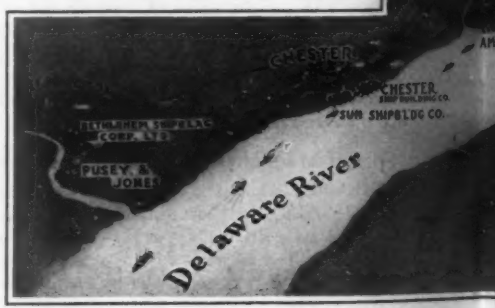
Construction of the Largest Shipbuilding Yard in Existence

A FEW miles below Philadelphia and on the right bank of the Delaware River, there is being constructed what is by far the largest single shipbuilding plant in the world. The site of the plant, Hog Island, consisted a few months ago of a flat, irregularly-shaped section of land, more or less marshy, and none of it over a few feet above the surface of the river. Its frontage on the river is approximately two miles; its greatest width is about three-quarters of a mile, and its total area about 900 acres.

The construction of the Hog Island yard was commenced on September 13th, 1917, by the American International Shipbuilding Corporation, which contracted with the Emergency Fleet Corporation to build fifty, 11½-knot, 7,500-ton cargo vessels, each 400 feet in length. On October 23d the company was awarded a second contract for the construction of seventy 15-knot, 8,000-ton combined transport-and-freight vessels, each 450 feet long.

The contract of the company for the yard contemplated a vast establishment, sufficient for the construction of not less than 200 vessels, in which the building of ships might continue as long as necessary on a scale and at a speed never before attempted.

Looking at the frontage of the Hog Island yard from the river one is impressed with the long line of shipbuilding ways, 50 in all, which occupy approximately a mile of the river front. Here are seen dozens of lofty pile-drivers putting down the foundations for the ways; large concrete mixers and plants for the construction of the concrete ways, one group of 10 ways being built of this material; and to the left, where the ways have been completed, are seen the lofty steel erection towers, surmounted by derricks, which flank the ways and serve to transfer the fabricated steel from the cars to the ship during construction. The rest of the frontage down stream, about three-quarters of a mile in length, is to be devoted to a huge fitting-out basin. Here, a large fleet of dredges is at work securing the necessary depth for the completed ships. Extending out into this basin from the shore will be built seven piers, each 1,000 feet in length, to which the hulls of the ships, as soon as they are launched, will be towed, and where the outfitting of the ships with boilers, engines, steam winches, etc., will be carried on.



The classification, storage and holding yards and the distributing tracks for the material entering into the construction of these 120 ships, requires 70 miles of standard gage railway track. The covered buildings, including the plate and angle shops, the forges and machine shops, etc., with the office buildings, mess halls, fire stations, police headquarters and

Pile driving in zero weather

Trucking difficulties on the road to Hog Island

Photo by Underwood & Underwood

Looking down a line of keel blocks

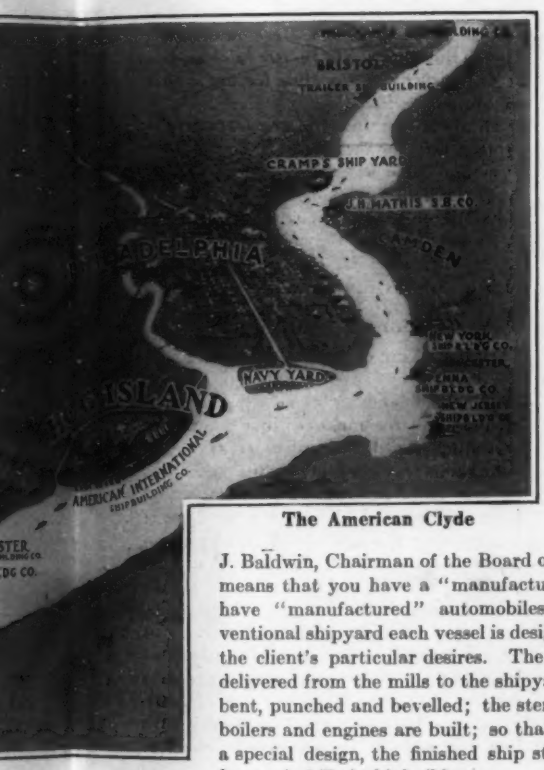
Photo Underwood & Underwood

General view of the barracks at Hog Island

Piles for shipways, before cut-off and capping

living quarters for the men, will include more than twenty-five acres under roof. About 75,000,000 feet of lumber will be used and about 500,000 tons of steel. When the yard is completed and everything is in full swing, about 30,000 men will be continuously employed.

With a view of expediting the work, the Emergency Fleet Corporation of the Shipping Board, designated Admiral Francis T. Bowles to take charge of the work in its behalf; and he is now in Philadelphia in daily contact, not only with this yard, but the other big Agency plants at Bristol and Newark in the construction of "fabricated" vessels.



The American Clyde

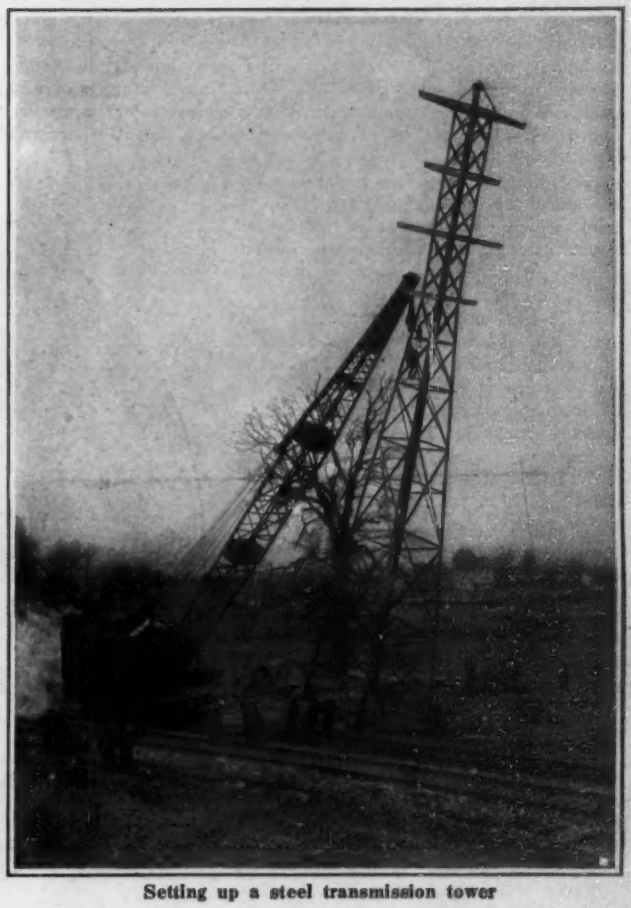
Admiral Bowles is well known throughout the country as one of the most able and experienced shipbuilding men in America; and he brings to this work his accumulated experiences as former Chief Naval Constructor of the Navy and as President, for many years, of the great Fore River shipbuilding plant at Quincy, Mass.

And now a word with regard to the character of the ships, 1,118 in all, which are being built at this and the other 116 yards throughout the country. The vast size of the leading yards, such as those at Hog Island and at Newark Bay, the layout of the plants, and the special type of construction employed in the ships, are all based upon the fact that this is an *emergency* problem, a fact which is expressed by the name of the body which has charge of the work: the Emergency Fleet Corporation. An insistent call had come from our Allies across the sea for the construction of the largest amount of tonnage in the shortest possible time. The fabricated ship and these yards big and little, scattered throughout the whole of our coastline, are the answer to that call.

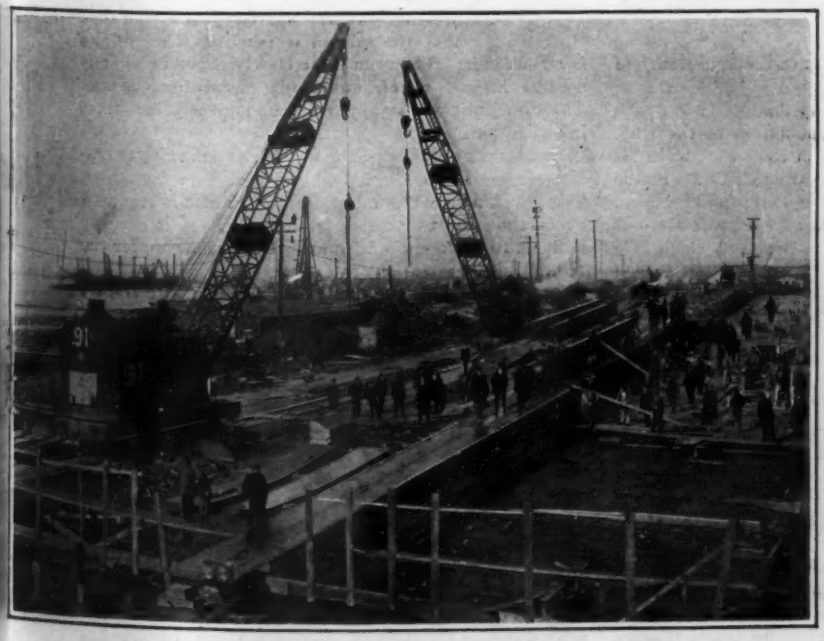
The "fabricated" ship idea, as defined by Mr. George J. Baldwin, Chairman of the Board of the American National Shipbuilding Corporation, simply means that you have a "manufactured" ship instead of a "made-to-order" ship; just as we have "manufactured" automobiles, instead of "made-to-order" automobiles. In a conventional shipyard each vessel is designed and the specifications are prepared in accordance with the client's particular desires. The steel and iron in the form of plates, ship's angles, etc., are delivered from the mills to the shipyards, where the plates are shaped and punched, the frames bent, punched and bevelled; the stern posts, connecting rods, etc., are forged; and the pumps, boilers and engines are built; so that every component part of the vessel, being worked out to a special design, the finished ship stands as an individual piece of workmanship by a trained force of skilled shipbuilders.

In the "fabricated" ship the various parts are made to standard specifications and drawings at hundreds of different mills, shops and factories throughout the country, and are delivered to the shipbuilding yard in such

(Continued on page 286)



Setting up a steel transmission tower



Laying the first keel on shipway No. 1

Half of the 50 shipways that border the Delaware

The Heavens in April, 1918

Astronomical Strangers from Heidelberg—An Asteroid and a Nova

By Henry Norris Russell, Ph.D.

TWO announcements of astronomical discoveries have recently reached America, a fter alittle delay, from the enemy's country.

Professor Wolf of Heidelberg—one of the most assiduous and successful among photographic students of the heavens—seems able, in spite of the war, to continue his researches. Of course, direct communication between enemy countries, even on purely scientific subjects, is impossible; but the arrangements for the transmission of astronomical news are among the few things that still survive, and information regarding discoveries of importance is telegraphed from either side to Copenhagen, where the Observatory acts as a central station, and sent thence to the rest of the world, belligerent and neutral.

The first of Dr. Wolf's discoveries—made at the end of January—looked at first rather puzzling, being reported as that of a "moving object" without attendant nebulosity, which might be a peculiar comet—like Neujmin's comet of 1913 which had very little nebulosity about its nucleus—or a new planet.

A Pigmy of the Skies

Later observations, leading to the calculation of a preliminary orbit, indicate that this body is moving in an elliptical orbit, of eccentricity 0.53, small inclination, and period four years; and subsequent messages refer to it as "Wolf's asteroid." It appears, therefore, that it is merely one of the thousands of minor planets; but, even so, it is remarkable on account of the very high eccentricity of its orbit, which exceeds that of any other known asteroid, and the small perihelion distance, which is only twenty millions of miles greater than that of the earth.

At the time of discovery it was just past perihelion, and was only about thirty-six million miles from the earth. It was moving so rapidly, in its orbit that, unlike an ordinary planet near opposition, it was actually overtaking the earth, and hence appeared to be moving eastward in the sky, instead of westward, as is the case near opposition for all ordinary planets, which are overtaken by the earth.

It was a very faint object—of the 13th magnitude photographically, according to observations at Harvard—in spite of the fact that it was so near us. This indicates that it is really a very small body. At the average distance of the asteroids at opposition, this newly discovered body would appear of the 19th magnitude, and could be photographed with difficulty, even with the great Mount Wilson telescope. The largest of the asteroids, Ceres, at the same distance, would appear about forty thousand times as bright. Hence we may estimate that the diameter of the newly discovered body is about $\frac{1}{200}$ of that of Ceres, or less than two and a half miles.

This little body will probably be observable only when near perihelion, and at the same time near the earth. But as. it has already been carefully observed, and is now well placed in the northern sky, it will doubtless be followed long enough to permit the calculation of a really good orbit, so that there is little reason to fear that it may become "lost" as some other interesting asteroids have been.

Another New Star

The second discovery—also made at Heidelberg on February 4th—is that of a new star in the constellation Monoceros, in right ascension 7h 22m 47s, declination, 6° 30′ 34″ south. When first observed it was of magnitude 8.5, and was recognized as a Nova by means of ts spectrum, which showed the peculiar broad bright bands characteristic of these temporary stars.

Examination of Harvard photographs showed that the Nova had been visible for fully a month before its discovery. On December 22, 1917, nothing was visible in the position of the object, but on January 1, 1918 it was of photographic magnitude 5.4 and must have been faintly visible to the naked eye, if any one had known where to look for it. A month later, at the time of discovery, it had lost more than nine-tenths of its light, and it is still fading.

By the end of February, the spectrum of the Nova had reached the nebular stage, as exhibited by many previous temporary stars—the bright lines in the green, of unknown origin, which appear in the spectra of the gaseous nebulae, being visible in addition to the hydrogen lines.

Like almost all other temporary stars, this one is in the Milky Way, and presumably at a great distance from the sun. It is apparently a typical object of the class, owing its sudden and enormous increase of luminosity to some catastrophic event—perhaps, as is supposed by many astronomers, to the collision of a star with nebular material. Like its predecessors, it will in all probability fade away till it almost, if not altogether, vanishes from our sight; and it is already so faint that it is of little interest to the amateur.

The Heavens

The brilliant winter constellations have now almost disappeared from our sight, being visible only low in the west, shortly after dark, and before the hour chosen for the representation of the heavens upon our map. At that time the Great Dipper is almost overhead and may serve as a starting point in our star-gazing. The line of the Pointers, at the front of the bowl, points downward to the Pole-Star, and beyond it to Cassiopeia—a zig-zag line of stars, now low on the northern horizon. The curve of the handle, continued southward, takes the eye to Arcturus—the brightest fixed star in sight. Below Arcturus, and a little to the right, is the fainter, but whiter star, Spica, in Virgo, and well to the right, and a little higher up is Leo, with the familiar and conspicuous "sickle." The planet Mars, which is on the borders of Leo and Virgo, is much brighter than any of the stars in sight, and adds greatly to the appearance of the region.

At 11 o'clock: Apr. 7.
At 10½ o'clock: Apr. 14.
At 10 o'clock: Apr. 22.

At 9 o'clock: May 7.
At 8½ o'clock: May 15.
At 8 o'clock: May 22.

At 9½ o'clock: April 30.

NIGHT SKY: APRIL AND MAY

Below Leo and Virgo is the long line of Hydra, with the small and inconspicuous constellation of the Cup, and the small but prominent one of the Crow, upon his back. Gemini and Canis Minor are well down in the west bearing the bright stars Castor, Pollux and Procyon. Cancer, which lies above them, has no bright stars, but enjoys at present the company of Saturn, which is a brilliant object.

Auriga is low in the northwest, and Lyra in the northeast. Hercules and Corona are higher up to the right, with Ophiuchus and Serpens rising farther south and Scorpio just beginning to appear in the southeast.

The Planets

Mercury is an evening star at the beginning of the month, and very well placed for observation. On the 7th he is at his greatest elongation; 19° 18′ east of the sun, (rather nearer than usual) but more than 6° north of him, so that he is a conspicuous object, remaining above the horizon till a little after 8 P. M. He is as bright as Arcturus or Capella—though, low in the twilight, he may not look so—and should be very easy to pick up. After the middle of the month he draws in very rapidly between us and the sun, and on the 26th passes through inferior conjunction, and becomes a morning star.

Venus is a morning star, and very bright, all through the month. She reaches her greatest elongation on the 21st and is then 46° 15′ from the sun, and rises about 2.30 A. M.

Mars is just past opposition, and is the most conspicuous object in the midnight sky, outshining all the stars (since Sirius is not in sight). At the beginning of the month he is moving slowly westward in the sky, but by its end he stands very nearly still and then recommences his eastward journey.

Jupiter is an evening star in Taurus setting about 11 P. M. at the beginning of the month, and 9.30 at its close and is brighter than anything else in the evening sky.

Saturn is in Cancer, not far from the star-cluster Praesepe, and remains in sight till 2 A. M. in the middle of the month.

Uranus is in Capricornus, and rises about 3 A. M. Neptune is in Cancer, some three and a half degrees west of Saturn, and is visible telescopically all through the evening.

The moon is in her last quarter at 9 A. M. on April 4th, new at 11 P. M. on the 10th, in her first quarter at the same hour on the 17th, and full at 3 A. M. on the 26th.

The moon is nearest the earth on the 10th and farthest away on the 22d, she passes near Uranus and Venus on the 7th, Mercury on the 12th, Jupiter on the 14th, Neptune and Saturn on the 18th, and Mars on the 21st. The conjunction with Jupiter is close, but occurs during the day time for us, so that we cannot see it.

All hours mentioned in the text and the caption of the map refer to Eastern Standard Time as at present constituted. After daylight saving goes into effect the clock time for the various phenomena will be an hour later.

Princeton University Observatory.
March 18th, 1918.

Reading Salmon Scales

THE marking of salmon, which has been carried out pretty extensively both in England and Scotland, has already resulted in the range of our knowledge regarding the life history of the royal fish being considerably extended. One of the most interesting points that has been established is the possibility of ascertaining the age of the fish by examining its scales. This was first propounded in 1904, and it has stood all the tests to which it has been subjected, by means of ringing and otherwise. Just as the age of a tree may be calculated from the number of concentric rings on a section of its trunk, so the age of a salmon may be determined by counting the lines on any of its scales—the shoulder ones for preference. In the case of the fish, however, the number of lines added each year is not one, but 16, and of course, they can only be traced by the aid of a microscope. The lines, it is observed, are more widely spaced during the time that the salmon is regaling itself on its favorite foods. They run more closely together when it winters in salt water, and leads an abstemious life. The differentiation is important and greatly facilitates investigation.

Besides the actual age, the number of spawning operations engaged in is also indelibly recorded on the scales. The spawning mark is a dark fracture, which is produced every time the fish enters fresh water. It is scarcely possible to confound it with any of the age lines, for the two sets differ essentially in appearance.

The practical value of scale reading, both with respect to age and spawning habits, can scarcely be exaggerated. By its aid, we have already discovered that the young salmon does not quit the fresh water in which it was hatched, until it is two years old. It descends to the sea about the middle of spring. In the course of the next season, it returns to its native river or lock, its object being to help in propagating the species. On performing this important duty, it again betakes itself, the next spring, to the sea. It may come back to breed next autumn, its return may be postponed for 18 months, or possibly it will spawn no more.

One of the most startling discoveries made by piscatologists in modern times, is that by far the greater number of salmon breed only once in their lives, and that the number that do so oftener than twice, is not more than one in 9,000.

Whichever Way the Blow Comes

Up—down—sidewise from all directions—at all angles—and with all degrees of intensity—a shower of blows is rained upon the bearings in the wheels of your motor truck.

If all of these blows were straight blows of a load down on the bearing, a set of balls or parallel-sided rollers would carry it.

If all of the shocks were direct from the side a set of "thrust bearings" would do the work.

But neither of these conditions corresponds to actual service.

The bearing in actual service has to resist not one or two simple loads, but countless loads from innumerable directions. A never-ending shower of little blows amounting to a fine vibration, is added to heavy pressure, or the sharp strong blow that comes from a drop into a rut.

The result is a force that is always changing in *direction — quality — magnitude;* never twice the same.

But it is just such hard service as this that Timken Bearings are made to sustain.

The tapered construction of the Timken Roller Bearing also makes it easy to take up the wear which will in time affect any type or design of bearing.

As the rollers wear smaller, the cone can always be advanced a little further into the cup. By a part turn of an adjusting nut you have a brand new bearing.

You can see what truck builders think about Timken Bearings by the extent to which they actually use them, at the points of *severe service*—wheels, knuckle heads, pinion or worm, transmission, and differential. This is all given in the booklet, "The Companies Timken Keeps." Just as a matter of keeping posted you ought to have a copy.

THE TIMKEN ROLLER BEARING COMPANY
Canton, Ohio

TIMKEN BEARINGS

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

PROTECTIVE SHIELD FOR AUTOMOBILE MECHANICS.—A. B. JONES, 83 Brookline St., Cambridge, Mass. The prime object of the invention is to provide protective back and knee shields for use by a mechanician or chauffeur working around and beneath an automobile or other vehicle, whereby to protect the clothing of the worker. The shields fold into compact form when not in use, and when in use are fastened to the body by straps.

DETACHABLE SHIRT CUFF.—F. J. ARNEY, 423 E. 162d Street, Bronx, N. Y. The object of this invention is to provide a detachable shirt cuff arranged to hold the cuff accurately in position on the shirt sleeve and give it the appearance of a cuff permanently attached. A further object is to dispense with buttons on the shirt sleeves and to permit the user to conveniently place the cuff in position on the sleeve and to secure it in place and close the sleeve by the use of a cuff button.

Pertaining to Aviation

FLYING MACHINE.—M. F. MORRISSEY, 93 Hazel St., Detroit, Mich. An object of this invention is to provide a flying machine utilizing feathering paddle wheel units for propelling and elevating by varying the adjustment of the paddles and in which a series of paddle wheels in each unit are so arranged that the paddles may jointly form in effect a unitary paddle extending the length of the unit, the paddles of the individual wheels of the unit being arranged to be adjusted for varying their lifting and propelling action.

Electrical Devices

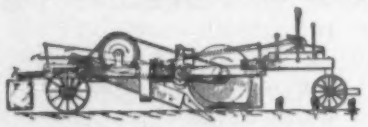
ELECTROLYTIC APPARATUS.—G. F. JAUBERT, Paris, France. The invention relates to a process and apparatus for the electrolysis of compounds, water for instance, from which gases are produced and are to be collected separately. The invention eliminates the use of diaphragms, at the same time enabling the two gases formed to be completely separated, and enabling simple apparatus to be constructed and greatly improved efficiency to be obtained.

TELEPHONE COLLECTION BOX.—O. A. PEDERSEN, 509 Willis Ave., Bronx, N. Y. Among the principal objects which this invention has in view are, to secure prepayment for certain forms of manually-controlled service, to disclose the amount of the payment, to collect the payment after the same has been deposited, and to provide means operable from a central station for accepting or rejecting payment for service.

REMOTE CONTROL ELECTRIC SWITCH.—C. E. PELLETIER, 814 St. Phillips Street, New Orleans, La. This invention relates to switches for electric circuits whereby the switch can be opened or controlled from a point more or less remote. The general object of the invention is to simplify the construction of electric switches of the character referred to, and so designed that they are capable of either automatic or manual operation, chattering is avoided, and positive closing secured.

Of Interest to Farmers

VEGETABLE HARVESTER.—J. W. RADKE, Box 142 Houghton, Mich. This invention has for its object to provide a mechanism of the character specified for topping and harvesting vege-



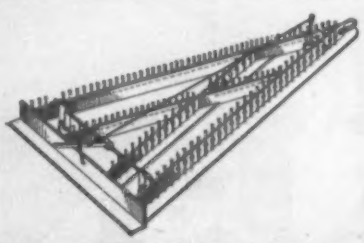
A SIDE VIEW OF THE MACHINE

tables such as potatoes, beets or the like, while they are in the ground, and for removing the tops from the machine and from the rows, as the machine moves forward.

DRILL.—H. M. SIEMANN, Fort Lupton, Col. The object of the invention is to provide a drill especially adapted for planting beet seed, wherein a floating shoe is provided for smoothing and leveling the ground before the seeds are planted, and a covering wheel is arranged behind the shoe for covering the planted seed, and a rake is arranged behind the shoe for providing a mulch to conserve the moisture in the ground.

Of Interest to Farmers

HARROW AND DRAG.—W. W. WARD, Dublin, Ga. The object of the invention is to provide mechanism especially adapted for use in leveling roads, wherein a series of closely arranged slightly projected harrow teeth is provided supported by a suitable frame, for tearing up the high



A PERSPECTIVE VIEW OF THE DEVICE

places in the road together with a drag for dragging the torn up material into the low places, mechanism is provided for supporting the harrow and drag out of contact with the road during transportation.

Of General Interest

ROPE GRIP.—B. B. BOSWORTH, 471 W. 145th St., New York, N. Y. The invention relates to rope grips, rope tongs, and similar devices for laying hold of and hauling in a rope, particularly for grasping firmly and hauling in the hand rope on elevating racks, awnings, tackle, etc. The object is to provide a device which is extremely simple in construction and efficient in operation.

COMBINED ROPE COUPLING AND TRAWLER.—B. B. BOSWORTH, 471 W. 145th St., New York, N. Y. The object of this invention is to provide a combined rope coupling and traveler arranged to securely fasten the ends of two ropes together side by side, and to provide a traveler or slide adapted to travel on a guide rod or a similar guiding member with a view to carry the coupled rope ends along with it.

DRAWING FRAME.—A. J. BARBER, care of Woonsocket Electro Plating Co., Woonsocket, R. I. The object of the invention is to provide a drawing frame for children, the body of this frame is made from one piece of sheet metal, the surface is made slightly convex to stretch the drawing paper tight and cause the same to grip firmly a pattern placed underneath. For this reason a

PERSPECTIVE VIEW OF THE INVENTION

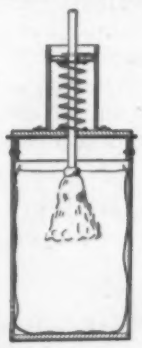
better quality of transparent paper can be used, upon which a child can color his drawings with crayon or paint. The child does not have to depend upon the paper and patterns supplied with the device, any subject can be selected, prints, pictures from magazines, papers, or post cards, can be used as patterns.

SHOPPER'S CATALOGUE.—H. B. ABEL, care of B. ALTMAN & Co., 34th St. and Fifth Ave., New York, N. Y. Among the objects of this invention is to provide a catalogue illustrating merchandise, each leaf of which carries a main design or series of designs, while there is associated with each of said leaves coupons carrying miniature designs corresponding to the main designs of the same leaf, provision is made for the removal of the coupons from the leaves, either singly or together, without impairing the printed matter of the main portion of the book.

MANIFOLDING DEVICE.—H. HANNERS, 51 Broadway, East Orange, N. J. Although capable of other uses, this invention is more particularly intended for manifolding express waybills which are required to be made in triplicate. The sections of waybills used by Express Companies are of different sizes, and it is the object of this invention to provide means superimposing the unequal sections for properly entering the written matter thereon.

FLOWER POT.—S. R. HARPER, 106 S. Cherry St., Bryan, Ohio. The invention relates particularly to a flower pot having the characteristic that a saucer is combined therewith and held in fixed relation by members serving as handles which as well as contributing to the ornamental appearance of the article serve as a means of supplying water to the plant through the handle to the orifices in the pot, portions of the handle being formed to constitute a funnel to facilitate the supply of liquid, the article may be employed as a jardinière.

SANITARY DUST-MOP SHAKER.—A. W. HARRISON and H. W. BASCOM, 328 Palmetto Drive, Pasadena, Cal. The principal object of this invention is to provide a simple device within which a dust mop may be cleaned and conveniently shaken without danger of scattering the dust liberated from the mop. Another object is to provide a container in the form of a paper lining within which the dust will be collected and from



A SECTION SHOWING DETAILS OF THE DEVICE

which it may be easily cleaned. The unsanitary distribution of dust by shaking the dust mop in open air is overcome by this device. The ordinary dust mops now on the market may be cleansed by this device. For private homes the device is easily operated by hand, but where large numbers of mops are in use, an electric motor may be applied to the mop handles.

Hardware and Tools

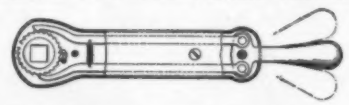
HORSEHOE.—R. C. HAMILTON, Aerial Gunnery Squadron, Royal Flying Corps, Camp Taliaferro, Freed 701 Fort Worth, Texas. The object of this invention is to provide a horse shoe having a detachable calk, there being an angular opening in the bottom of the horseshoe, and another opening spaced therefrom so that a projection on the calk may be inserted, and the calk may be turned to move the projection home, thereby disposing a second projection on the calk in position for insertion in the second opening. When the two projections are in position in the openings one is secured to the horseshoe to hold the calk in place.

MICROMETER.—W. F. KOCH, 434 5th St., Brooklyn, N. Y. This invention relates more particularly to the micrometer scale. An object is to provide a combination metric and English scale for micrometers so that conversion from one to the other can be made quickly and accurately as required in micrometric measurements.

OIL WELL JACK.—H. E. BROWN, care of El Dorado, Machine Tool Co., El Dorado, Kans. The invention relates more particularly to jacks for operating wrenches in coupling and uncoupling the drill rods of oil wells, but is useful in connection with hoist or track jacks and other tools. An object is to provide a lever mechanism for the jack whereby leverage may be compounded when desired, or adjusted to give direct action.

PENCIL SHARPENER.—T. A. RUDDLE and N. C. AHL, 1429 Mt. Vernon St., Philadelphia, Pa. An object of this invention is to provide a pencil sharpener having a drive means including a balance wheel on the shaft carrying the cutter head and adapted to be given momentum by a drive wheel engaging the same and arranged to be actuated from the exterior of the sharpener by tangential pressure thereon by the hand of the operator against the periphery of the actuating wheel, or equivalent impetus given to said wheel by the operator.

WRENCH.—E. L. ERICKSON, care of L. HALLUM, Aitkin, Minn. The object of this invention is to provide a ratchet wrench having a handle which under ordinary circumstances may constitute the main source of leverage for the turning on or off of a nut, together with ratchet



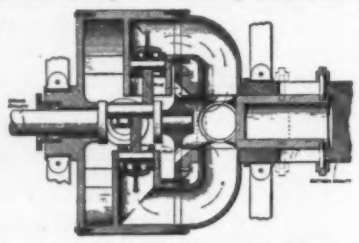
VIEW PARTLY SIDE ELEVATION AND PARTLY LONGITUDINAL SECTION

actuating connections extending longitudinally through the handle from the ratchet at one end, having a lever movable at the opposite end of the handle to actuate the ratchet independent of the handle in spaces of small compass where the latter cannot function.

Machines and Mechanical Devices

SET-OFF MECHANISM FOR LOOMS.—J. DUPUIS, 762 Globe St., Fall River, Mass. This invention relates to machine brakes, and has for its object to provide a device for automatically varying the tension on the warp roller of a loom in accordance with the varying conditions to which the roller is subjected as the warp is drawn off to provide for a continuous uniform web, which will be smooth and free from knots and roughness.

POWER TRANSMITTING MECHANISM.—M. KILLEY, and E. R. STEVENSON, Oakland, Ore. The principal object of the invention is to provide a noval device for transmitting power either at full speed or at any variation thereof which will be accomplished without the introduction of an elaborate system of gearing and thereby produce a mechanism of greater efficiency because of the



A CENTRAL VERTICAL LONGITURINAL SECTION OF THE DEVICE

elimination of the consequent friction occasioned by the use of gearing. Another object is to provide a fluid controlled power transmitting device which compresses a valved fluid passage through which the fluid is to be pumped by an arrangement of pumping pistons connected to the engine shaft.

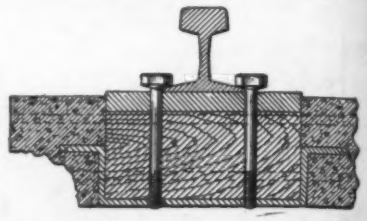
MOVING-PICTURE MACHINE.—M. J. VINIK, 188 Clermont Ave., New York, N. Y. The object of the invention is to provide a moving picture machine arranged to increase the length of time the film is at rest for the exposure of a picture and to shorten the time of the film motion when changing from one picture to the next following one to such an extent as to eliminate all flicker and to utilize a greater percentage of the arc light and to make it impossible to detect the change or the socalled "travel ghost" whether shutter is used or not.

Railways and Their Accessories

TRAIN STOP.—W. M. AVERY and J. B. BOOTH, 311 S. Mendenhall St., Greensboro, N. C. An object of this invention is to provide a mechanism for automatically stopping a train should the same through inadvertence or otherwise, pass a danger signal, and to this end a valve mechanism is operated by an automatically controlled electric circuit for establishing communication between the main reservoir of the air brake system and another valve mechanism actuated by air pressure, when said circuit is closed, to shut off the connection between said main reservoir and the train pipe, and at the same time, permit the escape of air from the latter whereby an application of the brakes is accomplished.

RAIL FASTENING.—S. B. KULL, 235 William St., Bridgeport, Conn. In this invention the object is to provide a rail fastening arranged to securely fasten the rail in position on the supporting plate and to fasten the latter in place on the railroad tie. Another object is to permit of unfastening the rail whenever it is desired to remove a worn out or defective rail for replacement by a new one or for other reasons.

RAILWAY TIE.—L. DUNCAN, P. O. Box, 985, Butte, Mont. This invention relates to railway track construction and has particular reference to railway cross ties. Among the objects of the invention is to improve that type of concrete or composition ties which are permanent, and to simplify the means for anchoring the rails to the concrete ties, cushioning material is provided



A VERTICAL LONGITUDINAL SECTION

and resting upon the upper surface of the cushion is a tie plate of metal. The tie plate and cushion are provided with vertical holes registering with threaded holes in the bed plate. The cushions may be easily replaced by removing the bolts, thereby allowing rails to be slid to one side of the track.

Pertaining to Vehicles

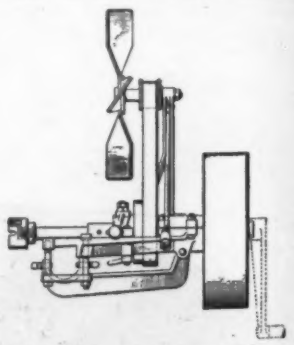
JOURNAL BOX.—L. E. KEIL, care of St. Louis Car Co., St. Louis, Mo. The invention relates to journal boxes for car axles, its object is to provide a journal box arranged to permit of readily removing the axle with the wheels mounted thereon from the truck without removing or disturbing the position of the bearing member of the journal box on the truck frame. The result is accomplished by the upper member of the journal box being rigidly attached to the truck frame and the lower member being removably attached to the bearing member.

DRIVE SHAFT TUBE SUPPORT.—H. O., W. L., and E. A. EKERN, address Ekern Bros. Mfg. Co., Flandreau, S. D. The invention relates to supports for the drive shaft tubes of automobiles. One of the objects is to provide a support which is light in weight, can easily be attached, and which will eliminate the vibration which

A PERSPECTIVE VIEW OF THE DEVICE

causes the tube to crystallize and break. A further object is to provide a support which is so constructed that it may be quickly applied to the final drive shaft, housing or tubes, such for instance as that of a Ford car, without necessitating any change in the housing or tube or in the differential casing to which the tube is attached.

STATIONARY POWER TRANSMITTING ATTACHMENT FOR AUTOMOBILES.—T. PAULSEN, Route 1, Sedro, Wash. The invention relates more particularly to power transmitting attachments for detachable engagement with an



A SIDE ELEVATION OF THE DEVICE

automobile frame, whereby the power of the automobile motor may be transmitted and utilized at an external point when the automobile is at a standstill, the object being to provide a simple, strong, and practical arrangement.

RUBBER TIRE PROTECTOR.—L. W. GEEREKEY, Decd. Address, Dr. J. A. Ketcherside, 237 Ulain St., Yuma, Ariz. The invention relates to that type of coverings or protectors for pneumatic wheel tires which are formed of metal sections conforming to the size and shape of the tire and suitably secured to the wheel rim or spokes. The invention comprises metal protecting sections and means for adjustably securing them to the tire, which consists of chains, plates and brackets applied to the wheel felly.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Our Shipping Problem

(*Concluded from page 273*)

the gases rushing each way between the water and the skin plating in all directions from the seat of the explosion, bending in the ship's side sometimes to a distance of 20 feet each way, besides blowing a great hole through it.

Concrete possesses peculiar properties of resistance to an explosive blast. The force of the blast is not readily transmitted through the mass of the concrete, and the energy is localized and absorbed in pulverizing the concrete. Furthermore, the strength and massiveness of the structure employed by me in this means of protection will effectually prevent the buckling in to any extent of the hull of a ship under the explosive blast.

The result of the explosion of a torpedo-warhead against this structure would be to smash a hole through the concrete wall, pulverizing the concrete, smashing three or more of the water compartments, and hurling the water upon and through the first steel screen, carrying the screen along with the blast to a certain extent.

The outer wall of the powdered coal cylinders in the path of the blast would be disrupted and the water-spray and powdered coal would be carried along together and hurled against the strong screen centrally located in the cylinders, and the gases of the explosion or water-spray and the pulverized coal would be intimately commingled, and although even this strong steel screen should yield or bend somewhat under the blast, it would not be entirely carried away or broken through and the gases of the blast would by that time be vented upward through the ship's deck and the energy of the blast so absorbed and dissipated that the inboard wall of the cylinders, that is to say, the bulkhead constituted by the inner walls of the cylinders, would be entirely uninjured and would not and could not be broken through by the blast.

Consequently, the only amount of water that could enter the ship would be that which would fill the space between the transverse bulkheads and the inner wall of the cylinders. If the blast should by chance strike upon one of these transverse bulkheads, then the space between two of these bulkheads and between the inner walls of the cylinders and the hull-wall of the ship would be filled with water.

Pulverized coal lends itself admirably as a buffer cargo barrier to the explosive blast of a torpedo. The fine state of division of the coal causes it to present to the gases a very large amount of surface, and as the specific heat of coal is about a quarter of that of water it will be seen that 30 tons of coal, the amount contained in one cylinder, would absorb as much heat as would be absorbed by seven and a half tons of water, and as we have in the water barrier directly in the path of the explosive blast five tons of water, the gases of the explosion of a torpedo will encounter a heat-absorbing barrier substantially equal to more than twelve tons of water.

But the pulverized coal has certain advantage not possessed by water, which is that it will not transmit the shock as will water, but will deaden and absorb it.

After the coal has been used from one of the cylinders, the cylinder may be filled half full of water, which will have a weight about equal to the full cylinder of coal, and will very effffectually serve as a barrier in place of the coal for resisting the blast. In the event that a torpedo should strike above the top of the water in the cylinder, the gases expanding against the upper surface of the water would deflect themselves upward through the vent hatch in the ship's deck.

There is one very important consideration to be taken into account in this method of protection against torpedo attacks, and it is that much of the destructive effect of the gases of a torpedo blast are due to the high velocity at which they enter and travel through the ship's interior. If these gases find an obstruction in one direction they instantly take another direction on the line of least resistance.

If 400 pounds of T.N.T., the quantity employed in the German torpedo-warhead, be hung against armor-plate 12 inches in thickness and exploded, it would not injure the plate in the slightest degree, because although the pressure upon the plate for a single instant would be enormous, the duration of the pressure on the plate would be too brief to produce any effect upon the enormous mass of metal, and the gases would rebound from the plate and expand in all directions away from the plate on the lines of least resistance.

This fact was admirably proven in the Gathmann shell tests at Sandy Hook when 600 pounds of high explosive were exploded against a 12-inch plate without damaging the plate.

For this same reason the gases of a torpedo explosion entering a ship protected in the manner I have proposed would be diverted and vented upward through the ship's deck. They would not have time to overcome the enormous resistance interposed in their path.

The use of pulverized coal is far past the experimental stage. It is an unqualified success. More than two hundred installations in the United States for burning pulverized coal are already in successful operation—in steel plants, in cement plants, and under steam boilers, and for numerous other purposes.

It can be piped to any required distance, just like oil, from cylindrical steel containers, under a pressure of less than fifty pounds to the square inch. This method is already in successful operation in many industrial plants on land, and it is just as practicable to use on shipboard as it is on land.

By this method coal may be carried in the steel cylinders I have indicated, and forced from those cylinders through pipes to the boiler room, and without the escape into the atmosphere of a particle of coal dust.

Formerly it was thought that because pulverized coal when exposed to the air is liable to spontaneous ignition and combustion, it would be dangerous to store it, but it has been found that if the coal be carried in airtight steel containers this danger is entirely eliminated, for the reason that any fire which might start from spontaneous ignition would immediately extinguish itself with its own gases or products of combustion.

Furthermore, if there were, which there is not, the least danger from spontaneous combustion, it could be entirely eliminated and obviated by the simple expedient of charging the cylinders with flue gases so as to exclude free air.

This method of ship protection will also at the same time test the very important question of using pulverized coal on ship board. Our oil supply is being consumed at a rate which threatens an oil famine. Pulverized coal may be burned without smoke on shipboard, just as is oil, and it is estimated that pulverized coal is 20 per cent more economical, that is to say, that it takes only four-fifths as much pulverized coal as lump coal to produce an equal amount of steam.

Again, by an adequate means of separating the slate and iron pyrites from crushed lump coal before it is pulverized—a system already tried out and demonstrated and available—a ship's fuel may be disencumbered of from five to ten per cent of its weight in inert material, so that when the economy in the use of pulverized coal and the economy derived from its greater purity are taken into consideration, no greater space on board ship will be required to carry it than is required to carry lump coal at the present time, while we will have a perfectly smokeless fuel and will conserve our oil supply; and last, but not least, we will be able to provide an ideal buffer barrier in the path of an explosive blast for the protection of our merchant shipping.

Paper Cups for Plant Pots

A DRUG store in Nashville, Tenn., saves all paper sanitary cups used at the soda fountain, turning them over to truck gardeners in that locality to be used as individual pots for starting seedling tomatoes, eggplants, cabbages, melons, etc. The seedlings are started indoors and afterwards set out in garden or field in the cups, thereby giving plants an early start.

The New Warfare of the Trenches

(*Concluded from page 274*)

its defense until such time as the heavier weapons have been brought up.

The F. M. receives a course of training no less thorough than other specialists of the French infantry. At the training camp he is developed into a trained athlete for his future duties. He is taught how to hold and aim the automatic rifle from the hip, which is something quitedifferent from firing from theshoulder. He is taught the importance of protecting the weapon against moisture and mud, which are apt to make it inoperative at a moment when everything counts on its rapid fire. He is taught to feign a fall on the battlefield, take advantage of every bit of natural cover, and rush enemy positions. Throughout the Hebert method of physical culture is followed, which method has done so much for the French infantry in developing military prowess.

How deadly is the automatic rifle? Well, that would be hard to say. Suffice it to give a single example which is indicative of its killing capacity: A single F. M., in an engagement at Maisons-de-Champagne, alone killed 35 Germans in a communication trench in a few moments' time.

What the French Assault Trooper Carries

The equipment of the infantryman has necessarily undergone marked changes. In the war of movement, for which the French and other armies were prepared, the requirements are altogether different than for the stagnant war of the trenches with the occasional quick dash into enemy positions.

The *tenue d'assaut* or equipment for attacking troopers at present comprises: Usual campaign uniform, without knapsack; tent cloth worn crosswise; shoe covers rolled with tent cloth; trench tool worn on the belt, and sometimes two tools; an ordinary pouch hanging on a shoulder strap and containing food, and a second, reinforced pouch for grenades and explosives; a two-liter canteen and a supplementary canteen of one-liter capacity for brandy; gas mask slung in front between cartridge cases, within convenient reach of the hands, and a second mask if possibe; two to five bags to be filled with sand and used in organizing positions, attached to tent cloth; signal flares or rockets; drinking cup and spoon carried in the pouch for grenades; first aid packet; individual notebook; identification tags, one carried at the neck and the other on a bracelet; food for regular use and emergency rations; and 120 cartridges and five grenades—three of the hand type and two of the rifle type.

It would be quite unfair and erroneous in the extreme to give all the credit to the infantry for the present efficiency of the French army. For other branches of the service, such as the artillery and aviation in particular, have certainly kept pace with the infantry. Indeed, the generally known fact that France is recognized as the leading nation in artillery of all calibers is proof enough that much of the brilliant French attacks and stubborn defensive actions have been due to that arm.

A modern attack is a strange sight. There is little of the dash of former warfare. The artillery places a moving barrage fire in front of the infantry waves which follow it closely over No Man's Land, at a walking gait. The detonations of the wall of shells produce a rolling, thunderous chorus, with a deeper, organ-like accompaniment in the distance from the guns themselves. To this is added the staccato notes of the wicked machine guns and rifles and automatic rifles, and the sharp reports of bursting grenades.

Artillery most assuredly plays an important part in any battle of today; but it requires a skilled infantry to make the most of the devastating effects of thousands of shells.

The Current Supplement

FOR the last 25 years the Alpine glaciers have been steadily decreasing, but of late they have shown decided symptoms of the beginning of an increase. An article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2204, for March 30th, on *The Variations of the Present Day Glaciers* discusses the causes for this, as well as various theories of the formation and mechanism of glaciers. *Spuds by the Millions* gives some interesting facts in regard to the growing of potatoes in Florida, which is in a way a new industry for that region. It is accompanied by several photographs. *Spitzbergen and Its Resources* contains much valuable information about an island that is unique in being practically a "No Man's Land" about which but scanty data have been published, although it is of considerable commercial importance. A map accompanying the article illustrates a curious condition of international occupation. The paper on *The Problem of the Method of Evolution* is concluded in this issue. *Army Kitchens* tells something about the methods of feeding the troops at the front, and is illustrated by a number of photographs. *Age Societies of the Plains Indians* deals with an exceedingly interesting ethnological problem of considerable importance to the understanding of Indian life. *Antiseptics* describes some important work that has been done for the British Medical Research Committee. *A Glass Polarimeter* describes a very simple and inexpensive instrument for illustrating the laws of optical rotation. Some excellent diagrams show the details of construction. *The Oldest Flint Implements* is a study of the methods by which paleolithic man made his tools. A number of these implements are illustrated and considered in detail. *The Sikhs* is a most readable history of one of the most remarkable races of India. There is much other material of value in this issue.

Ship Builder Versus Submarine

(*Continued from page 279*)

condition that the work is almost entirely one of assembling and erecting. Moreover, this work is so standardized and simplified that iron workers and machinists who may have had but little, if any, previous experience in shipbuilding, may quickly learn their tasks and become efficient "fabricated" shipworkers.

In the "fabricated" ship all nonessentials have been suppressed. Curvature of plates, especially those requiring multiple bending, is as far as possible eliminated. Ordinary structural steel beams are substituted for special ship shapes; there is no sheer, but a straight deck line from bow to stern. Other characteristics are: perpendicular sides and a flat bottom, and a strictly rectangular midships section curving only on the bilges; in a word, a design of boat carefully combining the best ship and bridge builders' practice with that of our most efficient manufacturers. Maximum cargo space is adjusted to maximum safety, utilizing a multiplicity of bulkheads, an arrangement which has saved more than one torpedoed oil tanker from going to the bottom. This designing has been so judiciously done, that the model tested in the Government testing tank showed a speed as great and required as little power as the average vessel turned out in our best shipyard practice.

Of the total program of Emergency Fleet construction, nearly 1,000,000 tons—or to be exact, 935,000 tons—was allotted to Hog Island. This total is made up of fifty, 7,500-ton ships and seventy of 8,000 tons; and the whole of this tonnage was to have been delivered within twenty months' time from the day of signing the contract. Largely because of the exceptionally severe winter, which affected not only the work on the island itself but the delivery of material over the heavily congested railroads, the construction of the yard is behind schedule, and, necessarily the cost has been greater than was anticipated. After visiting the yard, however, and going over the whole situation, the Editor is of the opinion that most creditable work has been done and that, judged as an engineering task of the first magnitude, the winter's work at Hog Island is creditable to those concerned in putting it through. That the contractors are confident of putting these 120 ships at the disposal of the Government on time, is shown by their estimate of deliveries.

(*Concluded on page 288*)

OUR FIRST YEAR OF WAR

APRIL 6th, 1917—APRIL 6th, 1918

A RECORD OF THE ACTUAL ACCOMPLISHMENT OF THE UNITED STATES DURING OUR FIRST YEAR OF WAR WRITTEN FOR THE

LIBERTY WAR NUMBER

OF THE

SCIENTIFIC AMERICAN

APRIL 6th, 1918

By the following Cabinet Officers and Department Heads

HON. JOSEPHUS DANIELS
Secretary of the Navy

HON. NEWTON D. BAKER
Secretary of War

HON. W. B. WILSON
Secretary of Labor

HON. JAMES HAMILTON LEWIS
United States Senator

MR. H. L. HORNING
Chief of the Automotive Section of the Council of National Defense

MR. GEORGE CREEL
Chairman of Com. on Public Information

MR. EDWARD N. HURLEY
Chairman U. S. Shipping Board

MR. HERBERT HOOVER
U. S. Food Administration

DR. HARRY A. GARFIELD
U. S. Fuel Administrator

MR. GROSVENOR CLARKSON
Secretary, Council of National Defense

Week by week the SCIENTIFIC AMERICAN has recorded in detail the work which has been accomplished in the prosecution of the war.

Such record is necessarily fragmentary and occasional.

In this issue (April 6, 1918) our whole effort during the twelve months at war is concisely and authoritatively stated by the various responsible members of the Administration in Washington.

The SCIENTIFIC AMERICAN will continue its public service to the Nation by publishing timely and authoritative articles dealing with every phase of industrial progress, as well as keeping its readers in close touch with important events in the War.

Subscription price one year (*52 issues and Liberty War Number*) ***$4.00.***

Use attached coupon.

Special Liberty War Number, Twenty-five Cents

MUNN & CO., Inc.

WOOLWORTH BUILDING **NEW YORK**

S. A.

Munn & Co.
233 Broadway
New York

Enclosed find four Dollars. Kindly send SCIENTIFIC AMERICAN for one year and Special Liberty War Number to

.....

.....

.....

.....

Ship Building Versus Submarine

(*Concluded from page 286*)

The value of time as an element in this problem is shown by the following considerations: The 935,000 tons of shipping now being built at this yard will, when it is finished, be capable of earning over $9,000,000 per month. This estimate is based on the rates fixed by the Shipping Board for steamers of 6,000 tons or greater dead weight capacity; and it proves that from the *commercial* standpoint, time is the very essence of this contract. Judged from the *military* standpoint, the value of a saving of time is beyond all possibility of estimate.

The construction company has made public some interesting figures as to the profits they expect to make on the ships. They are to receive a fixed fee of approximately $6,600,000, which is equivalent to 3.3 per cent upon the total monies expended. From this compensation must be deducted the excess profits tax, which will probably reduce the final net compensation about one-half. Out of the fee must be paid the salaries of executive officers, etc., and according to the company's figures the final net fee to the corporation will work out to about one and a half per cent.

And now a word as to the success of the ambitious and unprecedented policy of building a great fleet of merchant ships by quantity-production methods. Do the results already achieved warrant the belief that the program can be carried through on the vast scale on which it has been laid down?

We have recently put that question to Admiral Bowles, and his answer sums up the whole situation in a nutshell. "The success of the 'fabricated' ship program depends, first and last, upon coördination. At its inception, quantity-production of ships was a great experiment; but the work has been carried along to the point where it can be pronounced a success, *provided there is intelligent coördination of all the agencies and elements of labor, material, supplies and transportation.*"

"If we bear in mind the severe weather conditions of the past winter," said Admiral Bowles, "it must be admitted that the amount of work done at Hog Island is remarkable; but looking to the future, it is certain that if delays are to be avoided and the ships completed on time, the demands of the shipbuilding program must be given absolute priority over every other demand. The country must be brought to realize that the size of our Armies in France will be determined by the number of ships available to transport them overseas. *This means that everything which enters into ship construction should have absolute priority.* And this holds true, not only with regard to the main supplies of shapes and ship plates from the mills, but with regard also to the ouput of the sub-contractors."

As an instance of the lack of broad coordination, we may quote the case of an Illinois concern which, although it has a subcontract for 40,000 tons of rivets, was recently threatened with a complete shutdown because, being far down on the priority list, it was unable to secure supplies of oil fuel.

A well-adjusted priority list would see to it that shapes, ship plates and rivets arrived at the shipyard together.

A New Gas for Welding and Cutting

A GAS that is used for welding and cutting in the same manner as acetylene is acetylene enriched with the heated vapors of crude oil. The special feature in its production is the use of cartridges of material, consisting of alternate layers of calcium carbide and sawdust soaked in oil. It is necessary to wash, purify and cool the gas, which is generated automatically in a portable apparatus, as needed, and delivered to the torch at 15 pounds pressure.

It is well known that the volume of lime into which the calcium carbide is converted by the slacking process is greater than the volume of the carbide. Therefore, when carbide is packed tightly in cartridges, as desirable, the expansion is likely to burst the case and in some cases it might cause the cartridge to jam in the chamber, as well as interfere with the successful working. One of the objects, then, is to make the cartridge so as to allow for the expansion of the contents. Another, is to prevent the oil from coming in contact with the carbide as this would interfere with the action and decrease the gas output.

The cartridge consists of a tin can of suitable size, the smallest being 4⅜ inches in diameter and 8 inches high, weighing 6 pounds and having a gas producing capacity of 25 cubic feet; the largest 9¾ inches in diameter and 16 inches high, weighing 40 pounds. A cylindrical screen is first placed in the can to be filled and then a layer of carbide is placed in the bottom of the can around the screen tube. An unglazed cardboard disc is next placed on top of the carbide. A space, made of thin metal bent so as to lie edgewise, is placed on top of the cardboard and then a disc of screen is put over it. Sawdust in a cloth sack, impregnated with crude oil, is laid on the screen, then a space and a cardboard disc and so on to the top, ending with a sack of oil-soaked sawdust covered with a piece of screen that has no hole in the center for the cylindrical tube. The end of the can is closed with a cover for handling, which is removed before placing the can in a generator.

The water, feeding in through the valve in the cartridge chamber, dips down through the cylindrical screen tube and starts slacking of the cover layer of carbide, the heat of which vaporizes the oil in the sack above it. The cardboard discs, while strong enough to hold the layers firmly in place while dry, begin to soak up as soon as the feeding starts and consequently become soft so as to give way under the pressure of the expanding carbide, allowing it to be forced into the spacing between the carbide and the oily sawdust. Steam or water vapor must pass through the absorbent cardboard as well as the oil before it reaches the next layer of carbide. Action of the steam on the carbide above is thus prevented. This insures that the respective layers of carbide will not be acted upon until the water becomes level with them in turn. In consequence a cartridge can remain in a generator a long time without being spent. The screen discs in top and bottom of each layer of oily sawdust furnish efficient volatilization and egress of the gas.

There are several claims made for this new gas. It is heavier than air, and it is said it can be used at a lower pressure, slightly over 1,400 pounds, and at the ordinary atmospheric temperature; but it is not explosive when liquefied. The explosive ratio is from 12 per cent to 30 per cent air. An excess of oxygen is not required in the welding flame, so that there need not be any reduction of the carbon in the iron or steel which is being welded, thus producing a soft weld.

The Highest Possible Explosives

AT a recent meeting of the Swiss Society of Chemistry reported in *La Nature* (Paris), an interesting statement was read by a chemist named Stellbachen concerning the most violent explosives either practically or theoretically possible. Nitroglycerine, although considered one of the most violent in present use, develops only 1,580 calories per kilogram, since the nitric acid which it comprises does not take part in the reaction and the hydrogen and the carbon therein give only 43 per cent of the energy of combustion which they would disengage if they were alone. Explosives of liquid air, or oxyliquite, give as high as 2,200 calories because the liquid oxygen combines directly with the carbon and the hydrogen. The combinations of hydrocarbides with ozone, ozonide of ethylene and benzene triozonide, though liberating no more heat of explosion, have a higher "breaking value" because of the greater speed of decomposition.

Theoretically, still more powerful explosives are conceivable: a trichlorate of glycerine should develop 3,000 calories, twice the force of nitroglycerine; and finally, a mixture of liquid hydrogen and liquid ozone, if it were practicallyrealizable, would give about 4,500 calories and would be the most terrible substance possible to obtain.

Relieving Freight Congestion with Pierce-Arrow Trucks

THE collapse of the railroads in handling freight has not only imperiled many businesses but in some instances actually has threatened the life of communities.

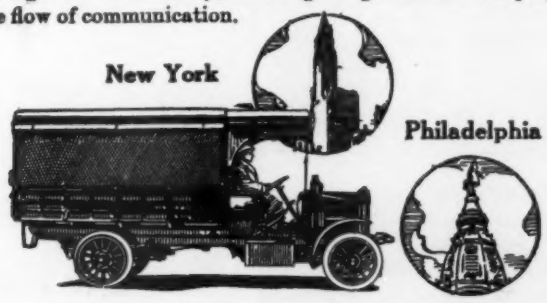
The Council of National Defense has urged business men to relieve the situation by employing motor trucks wherever possible, in order that the railroads may confine their efforts to the movement of coal and food and emergency war materials. Every truck employed in such service is doing a patriotic work of the first magnitude.

The truck is adaptable either to long distance hauling or to short hauling with many stops. It meets widely different conditions. Trucks must be utilized which exactly fit conditions as they are. Trucks cannot be operated efficiently and economically otherwise—even the best trucks made.

Pierce-Arrow trucks are sold to fit exactly the conditions of the individual businesses in which they are to be used. We maintain an efficient organization to study conditions and to see that the trucks make good.

For long hauls or short hauls, we have scores of installations in which Pierce-Arrows are more than meeting every demand.

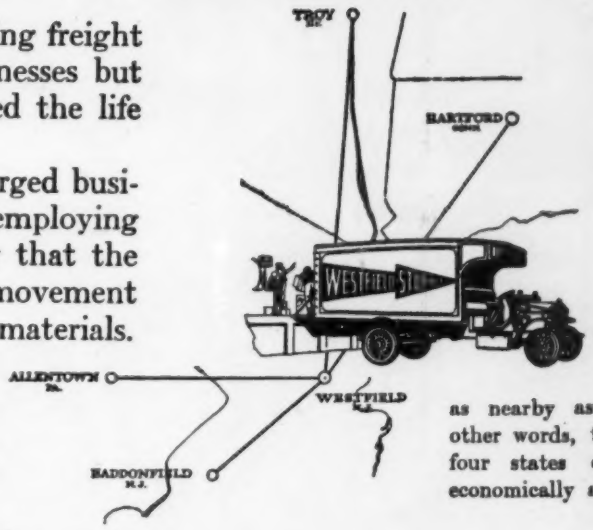
for instance: Daily deliveries between New York and Philadelphia, 180 miles round trip, can be maintained by many companies. The practicability of such service has been demonstrated by the experience of the United Gas Improvement Company, Pennsylvania Silk Dyeing and Finishing Co., Millers' No. Broad St. Storage & Warehouse Co., A. T. Baker Company, Lippincott's and others, saving time and money, relieving congestion and keeping uninterrupted the flow of communication.



This isn't a unique condition. It is being duplicated in many sections of the country, both over greater and lesser distances. OR—

for instance:

The Hansen Packing Company of Butte, Montana runs Pierce-Arrow trucks to Anaconda carrying fresh meat 26 miles in two hours—a material time and money-saving, but even more important, avoiding expensive loading and reloading and refrigeration.



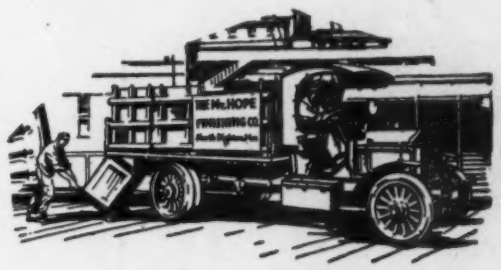
for instance:

The Westfield Storage Warehouse at Westfield, N. J., is delivering regularly to a dozen Connecticut towns, as distant as Hartford (240 miles); to as many New York State towns, as distant as Troy (208 miles); to as many Pennsylvania towns, as distant as Allentown (180 miles); to as many New Jersey towns, as nearby as Haddonfield (80 miles). In other words, these trucks are operating in four states over a 300 mile diameter economically and profitably.

Nor is this unusual. On a different scale, it is being done in the Pacific Northwest, in Oklahoma and elsewhere in the southwest, in Michigan and elsewhere in the Middlewest, in New England—in short everywhere, under varying road and climatic conditions, always overcoming different but difficult obstacles. OR—

for instance:

The Mt. Hope Finishing Company of North Dighton, Mass., gets material in two hours from Fall River, 12 miles away, which formerly required four days by freight—when they could get the cars—or in three hours from New Bedford, 25 miles away which frequently required ten days. The saving by water transportation instead of rail was insignificant compared to the importance of steady supply.



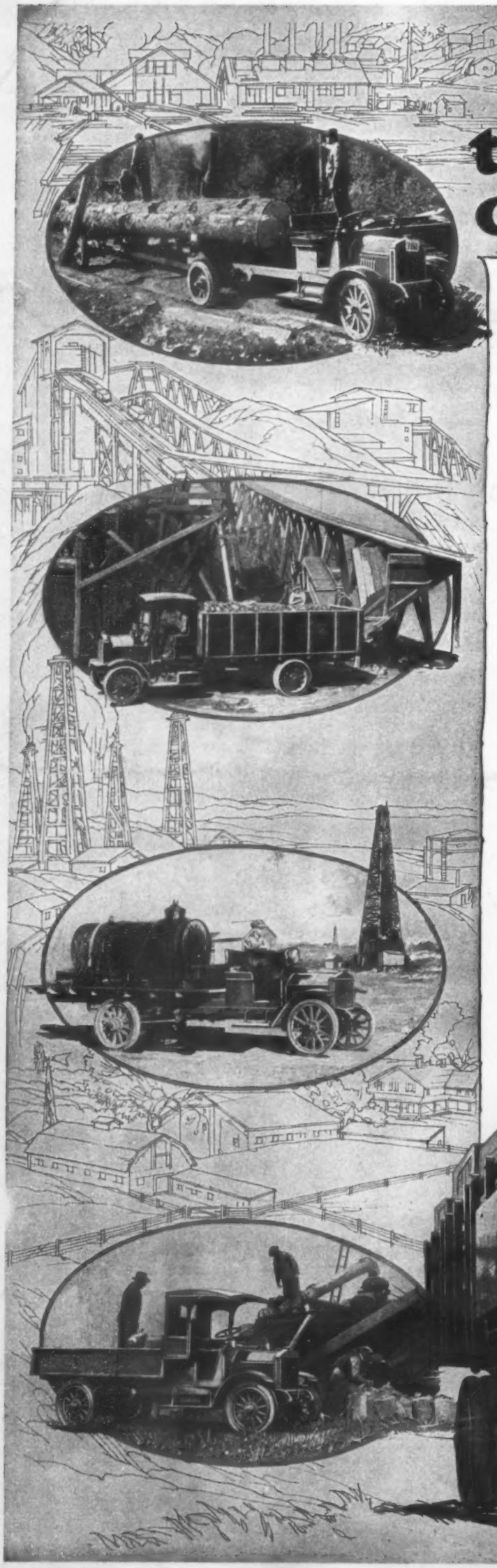
These are only isolated examples that don't begin to show the scope of Pierce-Arrow service or its adaptability in meeting emergencies growing out of present freight congestion.

Don't waste time deploring shipping delays, or wondering whether trucks can help you out. Send for us to show you what Pierce-Arrow trucks are doing in situations similar to yours—to meet your special needs. Unless they will do the work we won't sell them.

PIERCE-ARROW

Motor Trucks

THE PIERCE-ARROW MOTOR CAR COMPANY, BUFFALO, N. Y.



Releasing the Resources of the Nation

Hundreds of Federals are in service at the very outposts of industry.

It is here, perhaps, that they perform their most spectacular work, defying every hardship—surmounting every obstacle, that primitive conditions can impose.

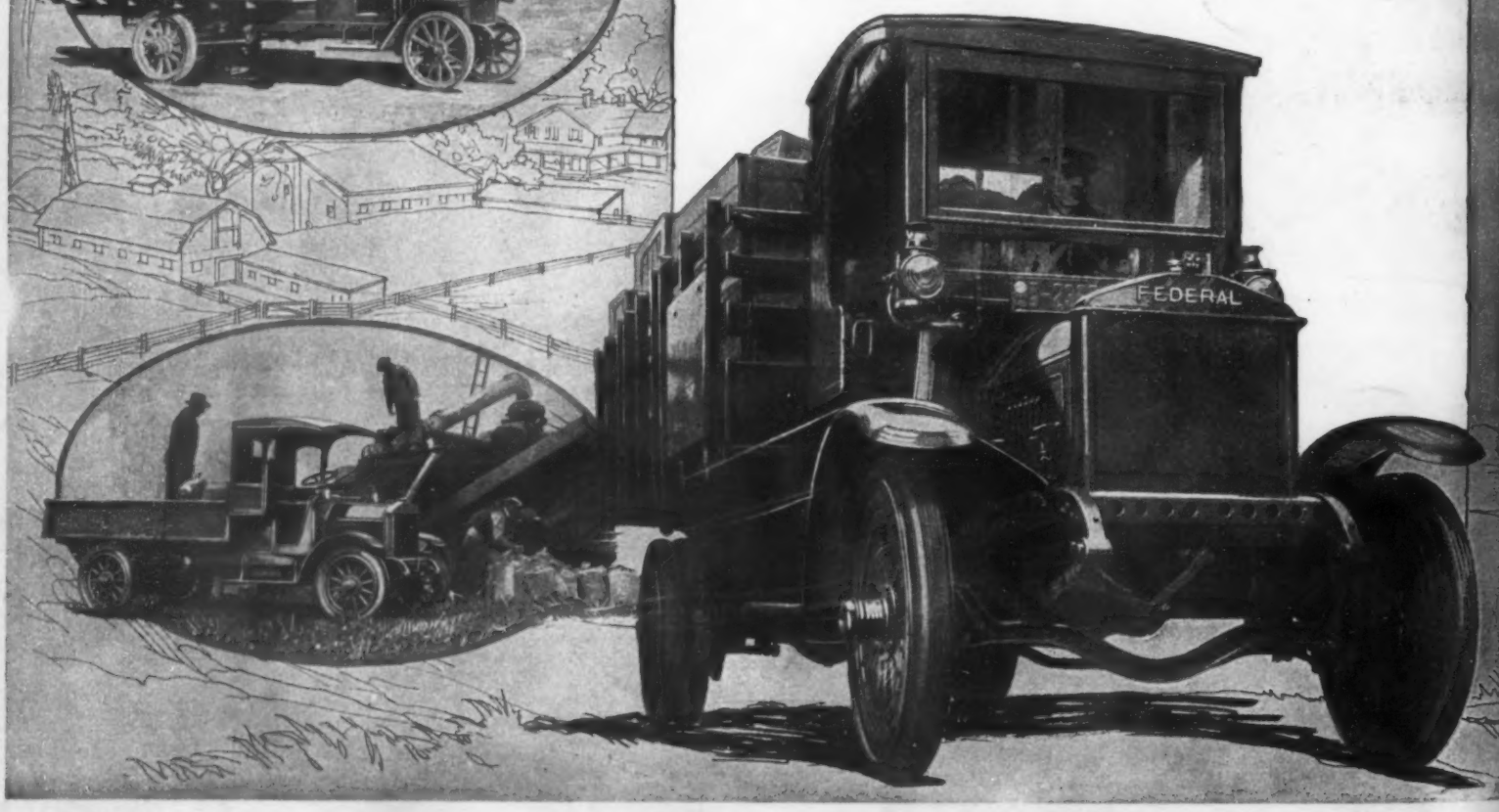
At the mines—in the lumber camps—on the broad prairie wheat fields you will find them, helping to release the richest of the soil.

In thus facilitating the development of the country—the prosperity and happiness of its people, efficient haulage has given Federals a well earned place as one of the nation's institutions.

Federal Motor Truck Company
Detroit, Michigan

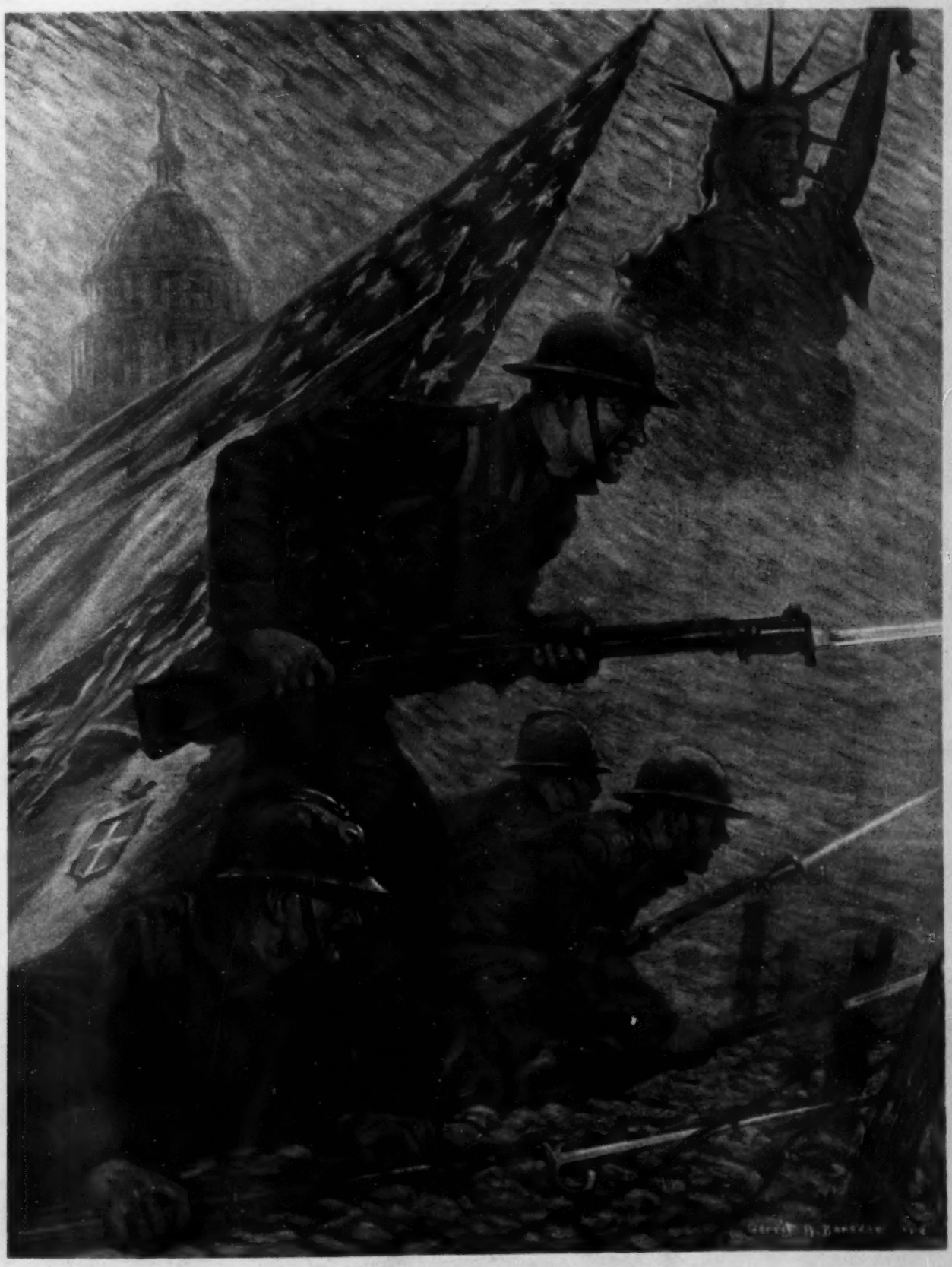
FEDERAL

A Capacity for Every Requirement



OUR FIRST YEAR OF WAR

SCIENTIFIC AMERICAN

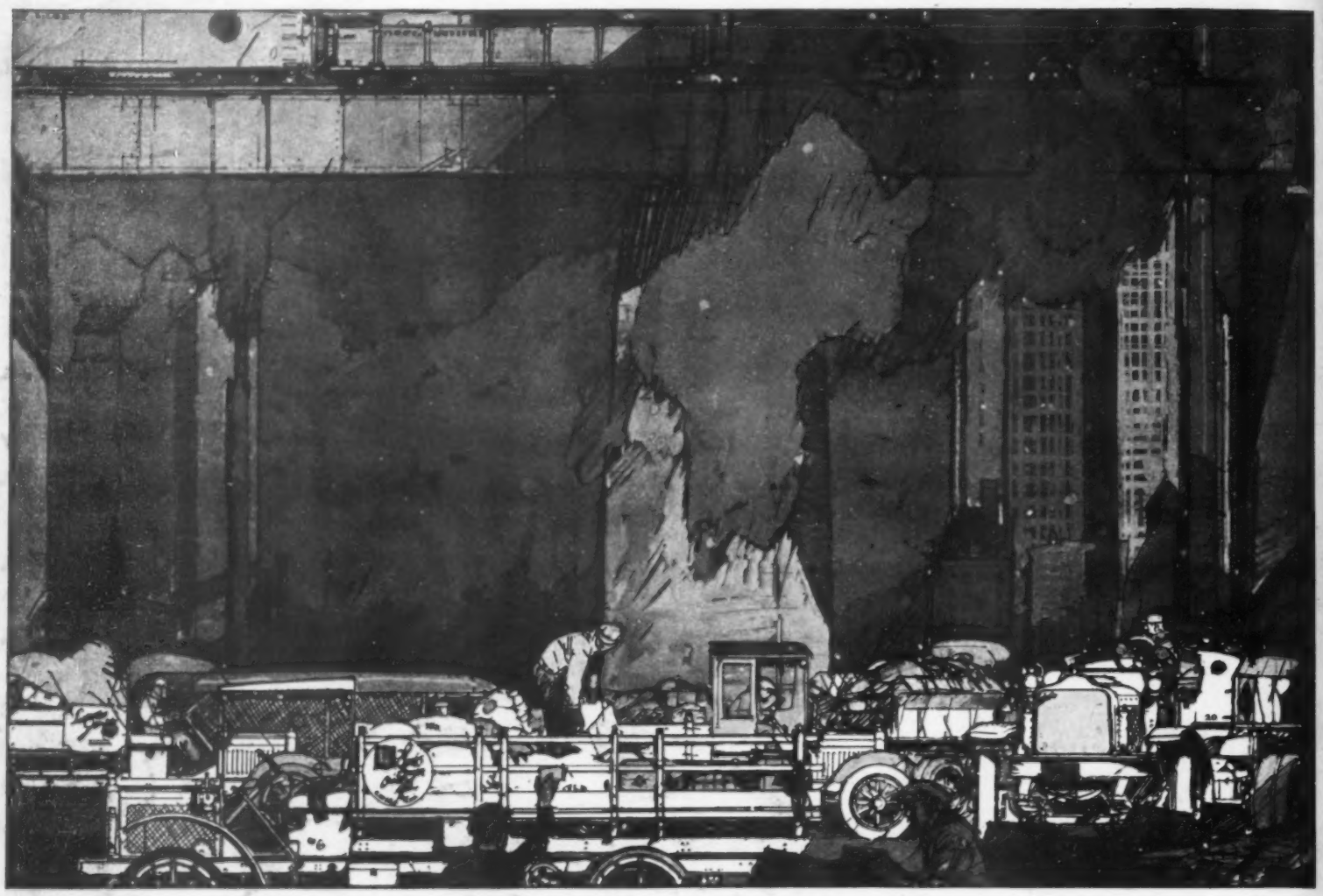


OVER THE TOP FOR JUSTICE AND LIBERTY

April 6, 1918

Munn & Co., Inc., Publishers
New York, N. Y.

Price 25 Cents



Delivery Costs in this Country Equal its Total Freight Bill

AUTHORITIES estimate that the American people pay as much for carting and delivering merchandise in towns and cities as they do for freight charges earned by all the railroads combined. This is a tremendous factor in the high cost of living.

Cartage from freight car to store door is an expensive item. There is no schedule about it. Consignees go for their freight whenever they get ready and often spend hours in getting it, due to congestion, and then carry away only part of a load.

CONSUMER PAYS OVER SIX CENTS OUT OF EVERY $1

An interesting investigation has been made recently by the Department of Commerce to determine the cost of retail delivery in the city of Washington. Figures obtained from 128 concerns doing one-third of the total retail business showed an average delivery cost of 6.2% of gross sales. Out of every dollar spent for merchandise *more than six cents was paid for delivering it.*

The actual cost, in different lines of business, ranged from 1½% to 45%. It totaled $8,000,000, as against $7,250,000 for inbound freight. Each family in Washington thus paid on an average $101.26 for retail delivery during the year 1916.

A SIGNIFICANT FEATURE

Costs varied widely for concerns in the same line of business. While individual conditions, volume of trade, etc., were factors, *inefficiency* and *waste* played a large part in this variation. Some concerns used horses for delivery; others used inferior trucks; and still others, including some of the foremost and largest concerns, used the *best grade* of trucks, whose operating efficiency is high and whose operating cost is correspondingly low.

THE REAL SOLUTION

War-time pressure now and peace competition after the war will inevitably force merchants and manufacturers to use the best trucks which can be built. They are the cheapest. True economy lies in the volume of performance steadily maintained over a long period of time. The investment charge is relatively small. Labor, fuel, depreciation, overshadow it. Any increase of the former which will decrease the latter effects a very substantial saving.

THE WHITE COMPANY
CLEVELAND

'Nobby Cord' *Solid Truck Tire*

United States Tires are Good Tires

Rubber's Part in Our Year of War

America has been at war exactly one year.

During that time rubber's part has been one of increasing importance.

As the largest rubber manufacturer in the world, the United States Rubber Company is bearing a proportionate share in the task of equipping America's forces.

Hundreds of thousands of rubber ponchos, arctics, boots and hats are making life livable for our men in the trenches and aboard ship,

—all of that high quality typified by the seal of the United States Rubber Company.

Millions of feet of insulated wire, rubber matting, rubber hose and many other rubber necessities from the same great factories, are in daily use by the army and navy.

United States Tires are seeing service on munition and supply trucks, ambulances, motorcycles and aëroplanes,

—meeting conditions at the fighting front with the remarkable resistance to wear that characterizes them everywhere.

United States Truck Tires have stood and are standing the test that war alone can give.

Give your commercial car advantage of tires that have proved their out-and-out dependability under all conditions.

You can get United States Truck Tires in two different types—the Solid Truck Tire and the 'Nobby Cord.'

For use at home or abroad, in war service or industrial work, United States Tires—either passenger or commercial car types—will give you the utmost in service.

Also Tires for Motorcycles, Bicycles and Aëroplanes

United States Tubes and Tire Accessories *Have All the Sterling Worth and Wear that Make* ***United States Tires*** *Supreme*

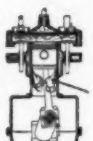
"Give me a quart of Oil"

This careless request may bring costly penalties

THE garage man comes out. The motorist says, "Give me a quart of oil." His "quart of oil" is poured into the crank-case, or reservoir. The car goes on. No doubt the motorist thinks he has amply protected the 1500-odd parts of his engine.

Far from it. *One of the surest ways to invite friction-drag and engine trouble is to say, "Give me a quart of oil."*

"Give me a quart of Oil" invites LOSS OF POWER

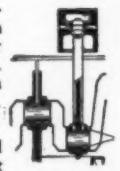


Escape of explosion past the piston rings, loss of compression and loss of power frequently result from oil of incorrect *body*. The power-loss is felt most on heavy roads and on the hills.

You can get full compression—complete power—only by using oil whose *body* suits *your* engine.

Correct body is seldom secured by saying, "Give me a quart of oil."

"Give me a quart of Oil" invites WEAR OF BEARINGS

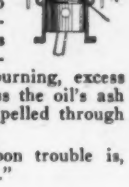


The problem of bearing lubrication is far from simple. Bearings differ widely in type and size. The oiling systems which supply them also differ. Adjustments vary.

Both the *quality* and *body* of the oil must suit these conditions. For every oil that suits your engine bearings, you will find many which will cause undue friction.

An almost sure start toward bearing trouble is "Give me a quart of oil."

"Give me a quart of Oil" invites CARBON DEPOSIT



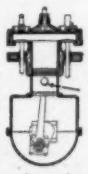
Guesswork won't eliminate this trouble.

Both the *quality* and the *body* of the oil must be considered.

Suppose the *body* is too light for the piston clearance. The oil then works too freely into the combustion chambers. In burning, excess carbon accumulates unless the oil's ash is light and naturally expelled through the exhaust.

An easy road to carbon trouble is, "Give me a quart of oil."

"Give me a quart of Oil" invites WEAR OF PISTON PINS

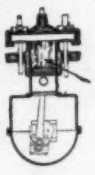


Piston-pin lubrication is a difficult problem and little understood.

The location of the piston pins within the heated pistons and the slight oscillating motion of the pins or bushings demand an oil which will spread readily, yet maintain the proper film between the pins and bushings.

Quick damage will come if the oil fails to meet these conditions. To encourage piston-pin troubles prematurely, it is only necessary to say, "Give me a quart of oil."

"Give me a quart of Oil" invites SCORED CYLINDER WALLS



Scoring frequently results from oil of low lubricating *quality*. Often, also, the oil's *body* is too light. Then the cylinder walls have no protecting film. Scratching results.

Too often the blame can be traced straight to "Give me a quart of oil."

"Give me a quart of Oil" invites NOISE

Noise is often a sign of worn parts—resulting from friction.

It may be a dull "thump" at every revolution of the main shaft. It may be "knocking" of worn piston pins. It may be "hissing" within the cylinders. It may be "knocking" caused by excessive carbon deposit.

When a comparatively new car pounds and racks its way along the roads it is seldom necessary to ask what brought on premature old age. Generally it is undue friction—resulting from incorrect lubricating oil. A way to invite premature noise is an off-hand request, "Give me a quart of oil."

"Give me a quart of Oil" increases MAINTENANCE COST

If the oil's *quality* is low, an excess quantity will be consumed and still the proper film will not be maintained.

If its *body* is incorrect, it may fail to reach and protect all moving parts.

In either case, excessive friction-drag results. Fewer miles are obtained from each gallon of gasoline. Your fuel and repair bills mount up.

This common waste is the frequent result of "Give me a quart of oil."

"Give me a quart of Oil" reduces SECOND-HAND VALUE

What fixes the selling price of a used car? (1) The condition of the engine. (2) The condition of the chassis. (3) The condition of the body.

The engine is the vital part of the car. The engine condition, therefore, is most important.

At an auction sale in New York City, second-hand cars of uniformly prominent makes were auctioned off. The bodies were in good condition. The prices of the cars originally ranged from about $1000 to $3000. *The selling price in some cases* was as low as $200.

Why? Because the engines and other mechanical parts were badly worn.

Was the wear due to long service? No. The age of most of these cars disproved that. *Premature* wear was evident.

It is safe to say the owners of these cars had used the common expression—"Give me a quart of oil." They paid a high price for their carelessness.

How to secure the Correct Oil for your car

DO NOT say, "Give me a quart of oil." You want an oil of the highest *quality* and of the correct *body* to meet the lubricating requirements of your engine.

Ask for that oil and get it.

At the right we print, in part, our Chart of Automobile Recommendations.

This Chart is the result of the most far-reaching and thorough study of automobile lubrication that has ever been made.

It was prepared by a company whose authority on scientific lubrication, for every class of machinery, is recognized throughout the world—the Vacuum Oil Company.

It was prepared after a careful analysis of the lubricating requirements of each make and model of American and foreign car.

For years this Chart has been recognized as the scientific guide to correct automobile lubrication.

The superior efficiency of the oils specified has been thoroughly proven by practical tests.

Make a note of the grade of Gargoyle Mobiloils specified in this Chart for your engine. Then make sure that you get it.

You will then give your engine oil of the *highest quality* and of the *correct body*. Its use will result in

Saving of fuel	Saving of oil
Maximum power	Minimum repairs

The requirements of the transmission and differential of your car are equally important. The correct grades of Gargoyle Mobiloils for the transmission and differential are specified in the complete Chart of Recommendations which you will find on your dealer's wall.

Write for 64-page booklet containing complete discussion of your lubrication problems, list of troubles with remedies, and complete Charts of Recommendations for Automobiles, Motorcycles, Tractors and Motor-boat engines.

In buying Gargoyle Mobiloils from your dealer, it is safest to purchase in original packages. Look for the red Gargoyle on the container. If your dealer has not the grade specified for your car, he can easily secure it for you.

GARGOYLE

Mobiloils

A grade for each type of motor

Correct Automobile Lubrication

Explanation: The four grades of Gargoyle Mobiloils, for engine lubrication, purified to remove free carbon, are:

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil "Arctic"

In the Chart below, the letter opposite the car indicates the grade of Gargoyle Mobiloils that should be used. For example, "A" means Gargoyle Mobiloil "A," "Arc" means Gargoyle Mobiloil "Arctic," etc. The recommendations cover all models of both pleasure and commercial vehicles unless otherwise noted.

This Chart is compiled by the Vacuum Oil Company's Board of Engineers and represents our professional advice on Correct Automobile Lubrication.

AUTOMOBILES	1918		1917		1916		1915		1914	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Abbott	Arc	Arc								
Abbott-Detroit			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)					A	A	A	A		
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	A
Apperson	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Auburn (4 cyl)					A	Arc	A	A		
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (6-34 & 6-39)			A	Arc	A	Arc				
" (6-39B) (Tester H)	A	Arc								
" (6-39B) (Cont'd)	Arc	Arc								
Autocar (2 cyl)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Briscoe	A	Arc	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)					A	A				
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Cadillac	A	A	A	A	A	Arc	Arc	Arc	Arc	Arc
Case	Arc	Arc	A	Arc	A	Arc	Arc	A	Arc	A
Chalmers	A	A			Arc	Arc	Arc	Arc	A	A
" (6-40)					A	Arc				
" (6-30)			A	A	A	A				
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (8 cyl)	A	A	A	A						
" (F A)	A	Arc								
Cole					Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A	A	A		
Cunningham							Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Dart	A	Arc	A	Arc	A	Arc	Arc	Arc	A	A
" (Mod. C)			A	Arc	A	Arc				
" (2 & 3½ tons)	A	A								
Detroiter			Arc	Arc	Arc	Arc	A	Arc	A	A
Dodge	A	Arc	A	Arc	A	Arc	E	E		
Dort	A	Arc	A	Arc	A	Arc	A	Arc		
Empire (4 cyl)	A	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc				
Federal	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod. S-K)	A	A	A	A						
" (Special)	Arc	Arc								
Fiat	B	A	B	A	B	A	B	A	B	A
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	A	A	A
Grant	A	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
Hal-Twelve			A	A	A	A				
Haynes	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl)	A	A	A	A	A	A				
Hollier (6 cyl)	A	Arc	A	Arc						
" (8 cyl)	A	A	A	A	A	A	A	A		
Hudson					Arc	Arc	Arc	Arc	Arc	Arc
" (Super Six)	A	Arc	A	Arc	A	A				
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Jackson			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Jordan	Arc	Arc	Arc	Arc						
Kelly Springfield	A	A	A	A	A	A	A	A	A	A
King							A	Arc	A	A
" (8 cyl)	A	A	A	A	A	Arc	A	Arc		
" (Cont'l)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Kissel Kar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" " (Mod. 48)					A	A	A	A	A	A
" " (12 cyl)	A	A	A	A						
Lexington			Arc	Arc	Arc	Arc	Arc	Arc		
Liberty (Detroit)	Arc	Arc	Arc	Arc						
Lippard Stewart	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" " (Mod. M)			A	Arc	A	Arc				
" " (Mod. MW)			A	Arc						
Locomobile	A	E	E	E	E	E	E	E	E	E
McFarlan	A	Arc	A	Arc	A	A	A	A	A	A
Madison	A	Arc	A	Arc	A	Arc	A	Arc		
" (8 cyl)			A	A	A	A				
Marmon	A	A	A	A	A	A	A	Arc	A	Arc
Marmon	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	A	A	A	A	A	A	A	A	Arc
" (22-70)							Arc	Arc		
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl)					A	A				
Moline-Knight	B	A	A	A	A	A	A	A	A	A
National	Arc	Arc	Arc	Arc	A	Arc	A	Arc	A	A
" (12 cyl)	A	A	A	A	A	A				
Oakland	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)					A	A				
Oldsmobile	A	A			Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Overland			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Owen Magnetic	A	Arc	A	Arc	A	Arc	A	Arc		
" (Mod. M23)	Arc	Arc	Arc	Arc						
Packard							A	Arc	A	Arc
" (12 cyl)	A	A	A	A	A	A				
" (Con'l)	A	A	A	A	A	A	A	Arc	Arc	Arc
Paige (4 cyl)							A	Arc	A	A
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
" (6-36)					A	Arc	A	Arc		
" (6-38-39)			A	Arc						
" (6-40)	A	Arc								
Paterson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Pathfinder			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (12 cyl)			A	A	A	A				
Peerless	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Pierce Arrow	A	A	A	A	A	A	Arc	Arc	Arc	Arc
" " (Con'l)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	A	A	A	Arc
Regal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
(8 cyl)					A	A	Arc	Arc		
Renault (French)					A	Arc	A	Arc	A	Arc
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Riker	A	E	E	E						
Saxon	E	E	E	E	E	E	E	E	E	E
Seldon			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (½ ton)			A	Arc						
Simplex			A	A	A	A	Arc	Arc	Arc	Arc
Stearns-Knight	B	A	A	A	B	A	B	A	B	A
" (8 cyl)	B	A	A	A	B	A				
Studebaker	A	Arc	A	Arc	A	Arc	Arc	Arc	A	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Velie (4 cyl)							A	Arc	A	Arc
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (2 & 3½ ton)	Arc	Arc								
" (½ ton)	A	Arc								
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (16 valve)	A	A	A	A						
Willys-Knight	B	A	A	A	B	A	B	A	A	A
Willys Six			Arc	Arc						
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

Electric Vehicles: For motor bearings and enclosed chains use Gargoyle Mobiloil "A" the year 'round. For open chains and differential, use Gargoyle Mobiloil "C" the year 'round.

Exception: For *winter lubrication* of pleasure cars use Gargoyle Mobiloil "Arctic" for worm drive and Gargoyle Mobiloil "A" for bevel gear drive.

VACUUM OIL COMPANY, New York, N. Y., U. S. A.

Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world

Domestic Branches:	Detroit	New York	Chicago	Indianapolis	Pittsburgh
	Boston	Kansas City, Kan.	Philadelphia	Minneapolis	Des Moines